Strategic Research Agenda for Urban Mobility

SRA Final Version

prepared by ECTRI

CONTRACT N°: TCA5-CT-2006-031372

ACRONYM:

EURFORUM

TITLE:

European Research Forum for Urban Mobility

PROJECT CO-ORDINATOR:

UITP	**Union Internationale des Transports Publics**

PARTNERS:

ECTRI	**European Conference of Transport Research Institutes**
TUD	**Technische Universität Dresden**
POLIS	**Promotion of Operational Links with Integrated Services**
CERTU	**Centre d'Etudes sur les réseaux, les transports, l'urbanisme et les constructions publiques**
ASSTRA	**Associazione Trasporti**
EMTA	**European Metropolitan Transport Authorities**

PROJECT START DATE: 01 April 2006 **DURATION:** 20 months

Date of issue of this report: 08 October 2007

Coordination Action funded by the European Commission under the Sixth Framework Programme for Research and Development (2002-2006)

Authors

This Strategic Research Agenda was produced by ECTRI with the collaboration of EURFORUM consortium members. Quality control was carried out by the project co-ordinator (UITP). Contact details of the persons who contributed to this report are given below.

UNION INTERNATIONALE DES TRANSPORTS PUBLICS (UITP)
Mr Laurent Franckx
Mr Yves Amsler
Mr Ulrich Weber
Rue Sainte Marie 6
B-1080 Brussels
Belgium
Tel.: +32-2-663 6665

E-mail: laurent.franckx@uitp.org

EUROPEAN CONFERENCE OF TRANSPORT RESEARCH INSTITUTES (ECTRI / DLR)
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
Mrs Barbara Lenz
Ms Claudia Nobis
Ms Anne Klein-Hitpass
Mr Steffen Barthel
Rutherfordstraße 2
D-12489 Berlin
Germany
Tel.: +49-30-67055-206

E-mail: Anne.Klein-Hitpass@dlr.de

EUROPEAN CONFERENCE OF TRANSPORT RESEARCH INSTITUTES (ECTRI / TNO)
Netherlands Organisation for applied Scientific Research
Mr Bart Egeter
Schoemakerstraat 97
N- 2628 VK Delft
Netherlands
Tel.: +31 15 269 6106

E-mail: bart.egeter@tno.nl

EUROPEAN CONFERENCE OF TRANSPORT RESEARCH INSTITUTES (ECTRI / INRETS)
Institut National de Recherche sur les Transports et leur Sécurité
Mr Alain L'Hostis
Ms Sandra Bozzani-Franc
2 avenue du Général Malleret-Joinville
F-94114 Arcueil
France

E-Mail: alain.lhostis@inrets.fr

EUROPEAN CONFERENCE OF TRANSPORT RESEARCH INSTITUTES (ECTRI)

Mr Dietmar Wurzel
Ms Caroline Alméras
ECTRI c/o INRETS
Case 24, 25 Av. François Mitterrand
69675 Bron
France
Tel. : +33-4-72-14-23-22

E-mail: caroline.almeras@ectri.org

PROMOTION OF OPERATIONAL LINKS WITH INTEGRATED SERVICES (POLIS)
Mr Sylvain Haon
Mrs Karen Vancluysen
Rue du Trône
B-1050 Brussels
Belgium
Tel.: +32-2-500 5671

E-mail: kvancluysen@polis-online.org

TECHNISCHE UNIVERSITÄT DRESDEN (TUD)
Mr Gerd-Axel Ahrens
Mrs Anne Pitrone
Mrs Jeannette Klotzsch
D-01062 Dresden
Germany
Tel.: +49-351-463 39483

E-mail: anne.pitrone@tu-dresden.de

CENTRE D'ETUDES SUR LES RESEAUX, LES TRANSPORTS, L'URBANISME ET LES CONSTRUCTIONS PUBLIQUES (CERTU)
Mr Jacques Bize
Mr Roland Cotte
Mrs Marie-Odile Gascon
Mr Jacques Nouvier
Mr Hubert Treve
Mr François Rambaud
9 rue Juliette Récamier
F- 69456 Lyon
France
Tel.: +33 472 745 862

E-mail: jacques.bize@equipement.gouv.fr

ASSOCIAZIONE TRASPORTI (ASSTRA)
Ms Francesca Pico
Piazza di Cola Rienzo 80/A

I- 00192 Rome
Italy
Tel.: +39 06 6860 3508

E-mail: pico@asstra.it

EUROPEAN METROPOLITAN TRANSPORT AUTHORITIES (EMTA)
Mr Jonathan Goldberg
Mrs Sabine Avril
Avenue de Villars
F- 75007 Paris
France
Tel.: +33.1.47 .53.28.64

E-mail: sabine.avril@emta.com

T-NEG partners:

CENTRUM DOPRAVNÍHO VÝZKUMU (CDV) v.v.i.
Transport Research Centre
Mr Vaclav Fencl
Mrs Radomíra Plíšková
Krapkova 3
CZ- 77900 Olomouc
Czech Republic
Tel.: +420-548.423.798
E-mail: pliskova@cdv.cz

VILNIUS GEDIMINAS TECHNICAL UNIVERSITY
Mr Algirdas Sakalys
Plytines 27
LT 10105 Vilnius
Lithuania
Tel.: +370 868661660
E-mail: Algirs@ti.vtu.lt

CENTRE FOR TRANSPORTATION RESEARCH (CETRA)
UNIVERSITY OF ZILINA
Mr Peter Fabian
Mr Pavel Surovec
Mr Marián Gogola
Univerzitna 1
SK- 010 26 Zilina
Slovakia
Tel.: +421 41 513 5010
E-mail: cetra@utc.sk

POLITECHNIKA KRAKOWSKA
Mr Andrzej Rudnicki
Ul. Warszawska 24
PL- 31-155 Krakow
Poland
Tel.: +48 12628 20 28
E-mail: Ar@transys.will.pk.edu.pl

TABLE OF CONTENTS

List of Abbreviations

ACARE	Advisory Council for Aeronautics Research in Europe
ADAS	Advanced Driver Assistance Systems
AVM	Automatic Vehicle Monitoring
BRT	Bus Rapid Transit
CADAC	Computer Assisted Data Collection
CIVITAS	Initiative for cleaner and better transport in Europe
CNG	Compressed Natural Gas
CTS	Cybernetic Transport Systems
DG	Directorate General
DRT	Demand Responsive Transport
EIRAC	European Intermodal Research Advisory Council
EPCIP	European Programme for Critical Infrastructure Protection
ERA-NET	One tool of the 7th Framework Programme to support the coordination of non-Community research programmes
ERRAC	European Rail Research Advisory Council
ERTRAC	European Road Transport Research Advisory Council
EU	European Union
EU – 12	Term for the EU-member countries that joined the EU with enlargements in 2004/2007
EUROSTAT	Statistical Office of the European Communities
FP	Framework Programme
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
ICT	Information and Communication Technologies
IPA	Impact Pathway Approach
ISTAG	Information Society Technologies (IST) Advisory Group
ITS	Intelligent Transport Systems
LPG	Liquefied Petroleum Gas
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
PDA	Personal Digital Assistant
PPP	Public Private Partnership
PRT	Personal Rapid Transit
PSR	Public Service Requirements

PT	Public Transport
R&D	Research and Development
RFID	Radio Frequency Identification
SoA	State of the Art
SRA	Strategic Research Agenda
SUTP	(Integrated) Sustainable Urban Transport Plan
T-NEG	Transportation in New EU-member countries – General Research Network for Harmonization and Integration
TP	Technology Platform: the European Commission has initiated the creation of so-called “Technology Platforms” as a means to develop European Research Advisory Councils supported by the supplying industry. “Technology Platforms” are “modal”, which means that each of them concentrates on a given transport mode: ERRAC for Rail, ERTRAC for Road, ACARE for Air and so on.
WHO	World Health Organization

0. Executive Summary

The European Research Forum for Urban Mobility (EURFORUM)[1] has now finalised its Strategic Research Agenda (SRA).

EURFORUM's Strategic Research Agenda addresses research issues in the particular field of urban transport considering all transport modes and focusing on intermodality for both passenger and freight transport. Technology-oriented as well as policy-oriented research is considered. The focus is directed on urban issues, including the transport between an agglomeration and its surroundings. EURFORUM's SRA relies on the conviction that holistic and interdisciplinary research is the most adequate approach to solve the problems identified in the area of urban transport. Additionally, special attention is paid to urban mobility changes in newly associated States (EU-12).

The overall objectives of EURFORUM are to better structure and to better coordinate European research on urban mobility for passengers and goods, by involving all relevant urban mobility stakeholders in the discussion.

EU policy context

In line with the Treaty of Amsterdam (which introduced sustainable development as an objective for the Community) and the Gothenburg European Council (which agreed on a strategy for sustainable development), the starting point of the 2001 White Paper on Transport Policy is that a modern transport system must be sustainable from an economic and social as well as from an environmental viewpoint. In 2006, the mid-term review of the White Paper introduced two important shifts compared to previous Commission position:

- The position that mobility must be disconnected from its negative side-effects rather than from economic activity;
- The introduction of the concept of co-modality.

[1] EURFORUM is a project under the leadership of the International Association of Public Transport (UITP). It was supported by the DG Research of the European Commission (Coordination Action under the 6th Framework Programme Thematic Priority 1.6.2).

The Green Paper on Urban Transport was adopted on 25 September 2007 and intended to open a debate on the key issues of urban mobility, with one overriding idea: “To be effective, urban mobility policies need to be based on an approach which is as integrated as possible”.

Throughout the text, and in line with the approach previously taken in the White Paper, a high emphasis is placed on the exchange of good practice as an instrument that could be promoted at the European level. The Green Paper acknowledges that there are big gaps in urban mobility statistics at the EU level and that there is a lack of common definitions.

Why this Strategic Research Agenda?

For several years, the European Commission has actively supported the creation of “Technology Platforms” (TP) in charge of defining the strategy for European research in the various transport sectors. However, these current advisory bodies are “modal platforms”, which can represent only to a limited extent a multimodal integral approach. Additionally, urban matters are in many cases very specific and cannot be compared with long-distance transport. Moreover, urban mobility is linked to a set of relevant stakeholders that go beyond those addressed by technology platforms.

In contrast with the existing “supply driven” TP, the starting point for EURFORUM is therefore the needs of the transport system user.

Why is it important that the EU supports this research?

Research on the EU level can address several particular objectives: promoting competition between technologies as well as promoting technical harmonisation, promoting "best practices" all across Europe and giving municipalities the tools they need to implement them. EU involvement in research also allows guidelines to be developed and priorities to be set.

In addition, harmonised EU regulations are desirable in certain areas. EU policy directly affects several areas of urban transport (e.g. regulation on PSR; state aid, competition and public procurement legislation).

As confirmed in the Green Paper, the EU’s particular action is needed for:

- Collection of data to evaluate and monitor the development of urban transport;
- Development of urban plans for sustainable transport;
- Implementation of sustainability strategies by best/good practice dissemination;
- Bringing up new and innovative urban research topics Europe- wide.

Who are the main actors in the field of urban mobility?

The key stakeholders identified as particularly relevant in the area of urban mobility are:

- Users and user-related organisations;
- Administration, political institutions and other not-for-profit organisations;
- Businesses (under public or private ownership);
- Research providers.

To successfully implement applied research and successfully support more sustainable mobility behaviour in cities, the users have to be put at the heart of research and development. Therefore, EURFORUM has proposed a permanent advisory structure at the European level, which can effectively represent stakeholders of European research on urban mobility.

The development process of the Research Agenda

The EURFORUM consortium composed a State-of-the-Art document (SoA) about urban transport research issues. Additionally a Vision for the Future has been formulated. The SoA and the Vision served as a basic input for the first stakeholder consultation round[2].

The outcomes were integrated in the SRA by the EURFORUM consortium. This SRA is based on the comparison between the SoA (where do we stand with respect to our knowledge) and the Vision (where do we want to be with respect to policy outcomes).

Integrating all comments, an improved draft of EURFORUM's SRA was presented and discussed during the second consultation round[3]. The outcomes of these discussions were integrated into the final version of the SRA.

Structure of the Strategic Research Agenda: Components of the urban mobility system

The Strategic Research Agenda for Urban Mobility is primarily structured around the four main components of the urban mobility system.

First, the two components of transport demand:

---

[2] This ended with a "Plenary session" organised in Brussels on 28th February 2007.

[3] The second "Plenary session" was held on 28th June 2007.

- The users' needs and behaviour: the starting point of both passenger and freight transport;
- The urban structure: land use, urban sprawl and the relationship with mobility and infrastructure.

Second, the two components of transport supply:

- Integrated mobility services: services (often ICT-based, like travel information and payment services) that enable a dynamic interaction between demand and supply;
- Integrated transport systems: the 'hardware' of the urban mobility system: road and rail infrastructure, and the operation of public and private road and rail vehicles.

Each of those four system components is assigned to a separate section in this chapter. Additionally, a separate section is dedicated to the subject of "data and models".

Each of the individual sections starts with a description of the specific topic followed by the main urban problems in this field. The core part of the chapters is the description of future topics for urban mobility research.

The section on "User Needs And Behaviour" covers the following topics for future research:

- Better understanding of the mobility behaviour of individuals and firms;
- Improving the accessibility and sustainability of our cities;
- Knowing the user: market research;
- Impact of policy measures and system innovations on mobility behaviour;
- Impact of societal changes on mobility behaviour;
- How to actively influence user behaviour;
- User acceptance analyses.

The section on "Urban Structure" covers the following topics for future research:

- Analysis and assessment of interactions between urban land use and transport;
- Making land development more sustainable through more efficient taxation;
- More efficient use of existing transport infrastructure;
- Developing approaches for integrated planning;
- Fostering the use of integrated planning approaches.

The section on "Mobility Services" covers the following topics for future research:

- Towards seamless multimodal transport;
- Compatible urban mobility services;

- Customisation of services;
- Development of sound business models and organisational frameworks;
- Technical issues.

The section on “Integrated Systems” covers the following topics for future research:

- Reducing negative impacts of urban transport (including: safety, security and environmental impacts);
- Integration of urban transport networks (including: infrastructure sharing, funding, intermodality, intelligent integrated network management);
- Implementation of new urban freight concepts;
- Strengthening of the alternatives to the private car (including: pedestrians and cyclists, better data for improved public transport operation, taxis and alternative modes, organisational and regulatory framework for urban transport, innovations in public transport infrastructure and rolling stock).

The section on “Urban Transport Demand Analysis and Modelling for Policy Support” covers the following research topics:

- Improvement of data collection on the issue of passenger transport;
- Improvement of data collection on the issue of urban freight transport through joint efforts;
- Standardisation of survey design and indicators for urban passenger and freight transport;
- Improving methods like data fusion and synthetic matching;
- Improving complementary data collection and reliability of data;
- Strengthening our understanding of user aspects by modelling user behaviour;
- Improvement of transport models integrating all fields of urban planning and management;
- Reduction of barriers for practical use of up-to-date models;
- Improvement of urban freight transport models and support of their application**.**

Key aspects for urban areas in the EU-12

One important aspect of the EU’s policy is the promotion of an overall harmonious development and strengthening of economic and social cohesion by reducing development disparities between the regions of the EU. Therefore the Union is seeking to stimulate the realisation of the full research potential of the enlarged European Union. Furthermore, urban areas in the newer member states of the EU might have other needs for research and implementation because of a different current situation in those countries. For this reason, EURFORUM was specifically seeking inputs from EU-12 states and looking at their needs.

However, there were no indicators that research needs in the EU-12 differ significantly from those of importance for other urban areas in the EU. It seems rather important to ensure practical and feasible easy access to research results from other research projects and to improve the transfer of experiences and good practice between urban areas.

1. Introduction

Improving and greening the urban transport system will mean a profound improvement in the liveability of European cities. To this end, more than ever before, sustainable solutions are needed in order to reduce the negative impact of transport on the urban environment. Solutions will have to strengthen and promote a well-functioning, attractive and energy-efficient transport system for passenger and freight transport. These solutions should allow for each city a specific combination of the private car, public transport and other modes like cycling or walking that is “optimal” in the sense that it meets mobility demand by addressing the users’ needs but also by following sustainability imperatives in a balanced way.

The year 2007 has been crucial for the future of urban transport in Europe. The European Commission has adopted a Green Paper ”Towards a new culture for urban mobility” on 25 September 2007. With this Green Paper, the Commission has launched a broad public debate regarding a possible European policy in the field of urban mobility.

Moreover, 2007 has also been a milestone for urban mobility *research*. Indeed, the European Research Forum for Urban Mobility (EURFORUM) has now finalised its Strategic Research Agenda (SRA). This SRA proposes a co-ordinated and integrated approach on mobility research focussed on urban areas. The EURFORUM SRA covers all urban private and public transport modes (by road, by rail and waterborne), and special attention is given to intermodal transport research issues. It focuses both on technology-oriented and on policy-oriented research and pays special attention to urban mobility challenges in the convergency regions.

EURFORUM is a project under the leadership of the International Association of Public Transport (UITP). It was supported by the DG Research of the European Commission (Coordination Action under the 6th Framework Programme Thematic Priority 1.6.2).

The overall objectives of EURFORUM are to better structure and to better coordinate European research on urban mobility for passengers and goods, by involving all relevant urban mobility stakeholders in the discussion.

EURFORUM’s Strategic Research Agenda takes up the set of issues which are considered crucial for the future development of urban transport:

- innovative strategies for clean urban transport,

- tools to support urban transport policy development, such as integrated planning and land use planning at the European level,
- exchange of know-how and dissemination of good practice experiences coming from different transport sectors,
- tools to fill the gap between available knowledge and realised implementation by identifying barriers and developing appropriate solutions,
- coordinated strategies on information and communication targeting transport users as well as operators and infrastructure managers,
- intermodality between existing mobility services and innovative intermodal mobility services in urban areas,
- improvement of the knowledge base on urban mobility Europe-wide (i.e. across agglomerations),
- urban mobility research, including and combining the subjects identified in existing modal technology platforms,
- appropriate links between existing modal "Technology Platforms" (ERRAC, ERTRAC, WATERBORNE, ISTAG, EIRAC, ACARE, etc.), in order to cover transversal/ intermodal issues addressing similar priorities (e.g. Traffic Planning, Traffic Management).

The concept developed by EURFORUM is to create room for innovative co-ordination and cooperation of stakeholders and decision-makers with regard to urban mobility research developed at the European level and supported by the European Commission.

In the first stage of the project, the EURFORUM consortium looked at the achievements of urban mobility research so far (State of the Art) and has formulated a Vision for the Future. This State of the Art has been used as a basis for the elaboration of a Strategic Research Agenda ("SRA", this document), i.e. a detailled action plan for the structuring and implementation of European research priorities in the field of urban mobility. Finally, the consortium has submitted a concrete proposal for the organisation and the composition of an urban mobility research EU advisory structure.

This SRA is structured as follows: We start by reminding the reader of the "EURFORUM's Vision of Urban Mobility in the year 2020" that was agreed upon during the preparation of the State of the Art report. Chapter 2 provides an overview of the EU Policy context in which this project must be placed. It pays specific attention to the recently published Green Paper "Towards a new culture for urban mobility" and explains the need for a specific Research Agenda for Urban Mobility on top of the existing modal SRAs. Chapter 3 identifies the specific contributions EU funding of research can make on top of the support provided by national or regional governments and pinpoints the main stakeholders in urban mobility research. Chapter 4 is the *core of this document*, as it contains the

EURFORUM proposal for a Strategic Research Agenda on Urban Mobility. This chapter starts by summarising the main steps that have led to the development of the SRA. Next, it explains how the SRA has been structured around the four main components of the urban mobility system (user needs and behaviour, urban structure, integrated mobility services and integrated mobility systems) on the one hand and a specific section on “data and models” on the other hand. For each component, it places the main research needs in the context of the most important urban problems in the field. Chapter 5 concludes.

EURFORUM's Vision of Urban Mobility in the year 2020: What should Urban Mobility look like?

Europe's towns and cities are the liveable homes of most Europeans and form vibrant centres of cultural and social interaction. At the same time they act as the motors of prosperity in an increasingly global economy, concentrating both knowledge and technical capacity.

In order to play this role successfully, towns and cities form the focus points of transport networks for persons and goods, on different scale levels and using different modalities. Urban mobility policies and transport systems are defined specifically bearing in mind the urban citizens' needs and expectations, whatever their age, physical ability and social condition.

Thanks to technical progress and changes in the regulatory framework, the future urban areas are able to cope with the negative impacts of their own success: congestion, urban sprawl, pollution, road accidents, economic and social exclusion.

Successful developments and applications of new transport technologies in European cities and towns have made Europe the major global player in the field of sustainable transport technologies.

According to this Vision, the following principles apply to urban mobility in 2020:

- European cities and towns are easily and equally accessible for people and goods. A well-organised urban transport supports the reduction of social and spatial segregation.
- Urban transport has developed into a more sustainable, effective and user-oriented system of integrated services and infrastructures, thus contributing significantly to the liveability and wealth of cities and ensuring freedom of movement. The urban transport system enables and eases co-modal travel.
- In 2020 urban policies have been more effectively linked with each other. There is a much stronger participation of all citizens, users, decision-makers and planners in the development and endorsement process of urban policies.
- A major contribution is made by the coordination of land use and town development planning with transport planning and mobility management. In many cities, plans are updated on a regular basis, at least every five years. Sustainable urban transport plans are mandatory in cities with more than 100,000 inhabitants.
- Cities and towns have understood and accepted their key role in the field of city logistics. City logistics have been better linked to urban policies, and the coordination of actors and interoperability of the infrastructures enable a more efficient and sustainable urban freight transport.

- Transport safety issues have been integrated into urban transport policies at a high level as well.
- Although the alternatives to traditional fossil fuels still have low market shares, traffic-related air polluting emissions (including greenhouse gases) have decreased significantly thanks to a combination of different factors: e.g. a higher modal share of public transport, cycling and walking; a higher use of shared private transport; increased fuel efficiency of vehicles and less congestion. Local air pollution in particular has decreased dramatically thanks to ever more demanding emission standards for both public and private transport.
- Innovative concepts and technologies have helped to curb noise pollution caused by urban transport.
- Among the population and decision makers there is a widespread acceptance of transport demand management strategies ensuring a more efficient use of existing infrastructure.
- The internalisation of all external costs into all modes of transport has facilitated a fair pricing system for mobility and enables a well-informed population to more efficiently use the urban transport system.
- The role of user-financed systems through road pricing and other integrated pricing strategies as a means for demand management has become more and more important inside and outside of cities. It ensures reliable financing of transport infrastructure and maintenance. The role of public transport, shared private transport and soft modes to reduce congestion is considered appropriately by being partially cross-financed through road charging.
- There is a continuous monitoring of land use and mobility patterns, of regulatory frameworks and practices, and of environmental and economic performance on the basis of agreed common indicators and measurable targets at the European level. Benchmarking with other cities and towns has been institutionalised.
- The regulatory framework for public transport enables competition in cities that wish to open up their services. Local authorities retain the freedom to choose the solution that best suits their capabilities and local needs. This framework provides incentives for operators to optimise their technical efficiency, and gives room for innovative entrepreneurship while protecting the interests of consumers. It allows financial transfers from the public budget to compensate for public service requirements.

2. The EU Context for Mobility Policy and Research

2.1 The EU Policy Context

Back in 1997, the **Treaty of Amsterdam** introduced sustainable development as an objective which has to be achieved by integrating environmental considerations into all Community policies.

The **Gothenburg European Council**[4] agreed on a strategy for sustainable development. Concerning the transport sector, it pointed out that a "sustainable transport policy should tackle rising volumes of traffic and levels of congestion, noise and pollution and encourage the use of environment-friendly modes of transport as well as the full internalisation of social and environmental costs. Action is needed to bring about a significant decoupling of transport growth and GDP growth, in particular by a shift from road to rail, water and public passenger transport."

In line with the Gothenburg Council, the starting point of the **2001 White Paper** (COM (2001) 370 final) is that a modern transport system must be sustainable from an economic and social as well as from an environmental viewpoint.

The following fundamental objectives for the Common Transport Policy were set (pp 2-3):

- restoring the balance between modes of transport and developing intermodality;
- combatting congestion;
- putting safety and the quality of services at the heart of all efforts;
- maintaining the right to mobility.

Based upon these objectives, a list of specific measures was proposed.

The section on *Urban Transport* (pp. 81-85) concluded that, in line with the principle of subsidiarity, and aware that most measures will fall within the jurisdiction of the national, regional or local authorities, the Commission intended to promote:

- support (using Community funds) for pioneering towns and cities, with each Member State remaining responsible for coming up with national plans;

[4] Presidency Conclusions, Gothenburg European Council, 15 and 16 June 2001

- increased use of clean vehicles and of forms of public transport accessible to all users, including people with reduced mobility (especially those with disabilities and the elderly);
- identification and dissemination of best urban transport system practice, including urban and regional rail services, and best practice in management of the relevant infrastructure.

In 2006, the **mid-term review** of the European Commission's 2001 Transport White Paper[5] stated that the "objective of a European Union (EU) sustainable transport policy is that our transport systems meet society's economic, social and environmental needs". It reaffirmed that the objectives of EU transport policy remained to help provide Europeans with efficient, effective transportation systems that:

- offer a high level of mobility to people and businesses throughout the Union;
- protect the environment, ensure energy security, promote minimum labour standards for the sector and protect the passenger and the citizen;
- innovate in support of the first two aims;
- connect internationally, projecting the Union's policies to reinforce sustainable mobility, protection and innovation by participating in international organisations; the role of the EU as a world leader in sustainable transport solutions, industries, equipment and services must even be better recognised.

These objectives put the Union's transport policy at the heart of the Lisbon strategy for growth and jobs.

Two important shifts compared to the 2001 White Paper are:

- The position that mobility must be **disconnected** from its negative side-**effects** using a broad range of policy tools. Thus, there is no longer a call for disconnecting growth of transport **volumes** from GDP growth;
- The concept of **co-modality**, i.e. the efficient use of different modes on their own and in combination.

Concerning *Urban Transport*, the Mid Term Review re-affirmed that the common challenge to all major cities is how to increase mobility while at the same time reducing congestion, accidents and pollution. It also repeated that the EU can promote the study and exchange of best practice across the EU in areas such as transport infrastructure, norm-setting, congestion and traffic management, public transport services, infrastructure charging, urban planning, safety, security and cooperation with the surrounding regions.

[5] Communication from the Commission "Keep Europe moving - Sustainable mobility for our continent".

It also announced the intention to publish a Green Paper on urban transport to identify potential European added value to action at local level.

This Green Paper[6] was adopted on 25 September 2007 and intended to open a debate on the key issues of urban mobility. The Commission explicitly expressed the objective to "set a new European agenda for urban mobility, while respecting the responsibilities of local, regional and national authorities in this field". Of specific importance for the EURFORUM project is that "the Commission intends to facilitate the search for solutions by, for example, *sharing best practices* and optimising financial means". The consultation process started with this Green Paper should result in an Action Plan (due in autumn 2008).

Both previous consultations and experience acquired by the Commission have led the Commission to the following overriding idea: "To be effective, urban mobility policies need to be based on an *approach which is as integrated as possible*, combining the most appropriate responses to each individual problem: technological innovation, the development of clean, safe and intelligent transport systems, economic incentives and amendments to legislation." This is clearly in line with the approach proposed by EURFORUM.

The Green Paper has identified the following five challenges that will need to be met as part of this integrated approach:

- Towards free-flowing towns and cities (this refers to the problem of congestion);
- Towards greener towns and cities (this refers to the problem of pollution);
- Towards smarter urban transport (this refers to the potential for Intelligent Transport Systems);
- Towards accessible urban transport (this refers both to the problems of people with reduced mobility in the broad sense of the word and to the quality of access that people and business have to the urban mobility system);
- Towards safe and secure urban transport.

Throughout the text, a high emphasis is placed on the exchange of good practice as an instrument that could be promoted at the European level. The Green Paper acknowledges that there are big

[6] Commission of the European Communities, Brussels, COM(2007) 551 DRAFT, Green Paper, Towards a new culture for urban mobility.

gaps in urban mobility statistics at the EU level and that there is a lack of common definitions. It suggests the creation of a European Observatory on Urban Mobility. It also refers explicitly to the activity area "Ensuring sustainable urban mobility" and to the launch of CIVITAS-Plus under FP7.

2.2 European Research on Mobility: Why another Strategic Research Agenda?

EURFORUM's Strategic Research Agenda addresses research issues in the particular field of urban transport considering **all transport modes** and focussing on **intermodality** for both **passenger and freight transport**. Technology-oriented as well as policy-oriented research is considered. The focus is directed on urban issues, including the transport between an agglomeration and its surroundings. EURFORUM's SRA relies on the conviction that holistic and interdisciplinary research is the most adequate approach to solve the problems identified in the area of urban transport. Additionally, special attention is paid to urban mobility changes in newly associated States (EU-12).

Why this Strategic Research Agenda?

For several years, the European Commission has actively supported the creation of "Technology Platforms" (TPs) in charge of defining the strategy for European research in the various transport sectors. However, these current advisory bodies are "modal platforms", which can represent only to a limited extent a multimodal integral approach. Additionally, urban matters are in many cases very specific and cannot be compared with long-distance transport.

The need for EURFORUM's SRA has emerged against the background:

(1) that urban mobility is of particular importance within the European context with 60% of Europe's population living in cities[7];
(2) that the focus on urban mobility is a necessary complement to the focus put forward by technology-driven modal research agendas;
(3) that urban mobility is linked to a set of relevant stakeholders that go beyond those addressed by technology platforms.

EURFORUM's SRA identifies priority research areas in the field of urban mobility which would benefit from a better **coordination** of stakeholders at the **European** level. EURFORUM's recommendations will help to offer a better service to the urban transport users, whatever transport

[7] Cities of over 10,000 inhabitants (source: Eurostat).

chain they use (a better “mobility for all”). Therefore, the starting point for EURFORUM is the needs of the transport system *user*.

EURFORUM relies on a wide network of urban mobility stakeholders, participating in EURFORUM stakeholder consultations, where key findings of the project have been discussed and validated. The most relevant actors and stakeholders on urban mobility are integrated in this approach.

EURFORUM has established links to EU Technology Platforms (TPs) which also cover some urban transport issues. Those are mainly ERRAC for Rail, ERTRAC for Road, ACARE for air, WATERBORNE (self explanatory), as well as EIRAC for intermodal freight. They are all actively supported by the European Commission. Due to their “supply industry driven” nature, urban issues represent only a small aspect among other very important topics detailed in the relevant TP Strategic Research Agenda (all available). Specific questions of inter- and multimodal transport in cities cannot be covered in depth in the TPs, and none of them is in a legitimate position to cover all cross-sectoral (transverse) matters. Thus, the project fills the gap between existing technology platforms and raises the priority of urban mobility research within European, national and local research programmes.

3. EU Support in a Context of Subsidiarity

3.1 Why is it Important that the EU Supports this Research?

As explained in Chapter 2 the EU has promoted sustainable mobility as a policy goal. This position, first formulated in the 2001 Transport White Paper, has been confirmed by the mid-term review and by the recent Green Paper. Research at the EU level is indispensable in order to pave new ways of development.

However, many successful developments and initiatives for "sustainability in transportation" are being conducted only on a regional or national level. As emphasized in the Green Paper, research at the EU level can address several particular objectives: promoting competition between technologies as well as promoting technical harmonisation of systems and/or subsystems and/or components and their interfaces, developing forms and instruments in order to publicise "best practices" all across Europe and give municipalities the tools they need to implement them. EU involvement in research also allows guidelines to be developed and priorities to be set.

In addition, harmonised EU regulations are desirable in certain areas, being often crucial for the successful development of new solutions, whether of a technological or organisational nature. The EU directly affects several areas of urban transport (e.g. regulation on PSR; state aid, competition and public procurement legislation).

The particular role of the EU within research into urban mobility is integration and harmonisation of efforts, including standardisation aspects where necessary. Only the EU can tackle efficiently the problems of legal harmonisation, standardisation and interoperability.

As confirmed in the Green Paper, the EU's particular action is needed for:

- § Collection of data to evaluate and monitor the development of urban transport;
- § Development of urban plans for sustainable transport;
- § Implementation of sustainability strategies by best/good practice dissemination;
- § Bringing up new and innovative urban research topics Europe wide.

Collection of data

EU involvement is essential for the development of a common standard for data collection on urban transport issues including data on land use.

As a prerequisite for good data there is an important demand for empirical work, especially for socio-economic issues. In order to obtain statistically meaningful results, a large sample with an important variance in the values of the explanatory variables is needed. This requires the examination of different physical and institutional contexts, and thus different countries, by using a common vocabulary (and thus a minimal amount of standardisation).

Through its cooperation with national governments the EU can bring together all relevant actors and ensure the implementation of standards. EU involvement will be helpful additionally to promote continuous and efficient data collection at the local level. Local pilot projects can help to overcome barriers for the realisation of data collection and support the use of new data collection methods.
The data problem does not only concern passenger travel, but is still one of the major problems in the freight sector. There is a complete lack of reliable, frequently updated flow data. For planning and traffic management issues in the urban context, flow data by origin–destination are indispensable. Data are also missing to support long-term strategies. It is up to the EU to introduce the relevant data collection incentives and standards, which are required to provide appropriate input for the European Observatory on Urban Mobility (the creation of which is recommended in the Green Paper “Towards a new culture for urban mobility”).

Development of sustainable urban transport plans

In its thematic strategy on the urban environment released in 2006, the European Commission has expressed its strong intention to support the development of sustainable urban transport plans in cities and towns[8]. This interest has been confirmed in the Green Paper on urban transport. These plans will be based on the application of comprehensive analysis and forecasting with up-to-date methods and models.

Analysis will have to bring forward understanding of the relationship between land use, mobility, accessibility and transport demand at the local and regional level. As suburbanisation and urban sprawl are problems known in all EU member states a consistent view and understanding is important. National governments and the European Commission should develop guidelines for comprehensive integrated urban transport and city planning, serving also as a mandatory basis for any funding[9].

[8] http://ec.europa.eu/environment/urban/pdf/com_2005_0718_en.pdf

[9] As recommended by the PILOT project: http://www.pilot-transport.org

Implementation of sustainability strategies by best/good practice dissemination

The lack of knowledge about good solutions is one of the major barriers for improving sustainability of transport systems in cities. There is a demand for dissemination and coordination of knowledge. For the EU, these aspects are an integral part of research to avoid duplication of research: new developments, solutions or topics that have been implanted somewhere remained often unknown until a European project raised awareness[10].

The dissemination strategies are directly related to economic, technological, user, safety and security issues:

- While supporting the exchange of best practices in functionalities, organisational and technological issues, the EU also enables the achievement of economies of scale or a reduction in life cycle costs in developing interchangeable system components.
- From a transport user perspective, the implementation of EU driven strategies also contributes to the harmonisation of user functionality of services, making travel between European cities more convenient. Thus European cities are getting more accessible for everybody, which is a basic requirement for helping European countries grow together.
- Safer cities in Europe and sustainable mobility can be of interest for other countries.
- Terrorism is a problem for Europe as a whole. Only a combination of sound organisational practices, surveillance and detection systems, etc. is possibly able reduce the frequency and intensity of those attacks. Therefore, best practice exchange between operators on the most appropriate ways to improve security (depending on local circumstances) should be promoted, It is also important to increase the knowledge base about possible security strategies (and systems), addressing the unique character of mass land passenger transport in all its different aspects.

Bringing up new and innovative urban research topics Europe-wide

European cities share a characteristic structure; hence they require a typical transportation system design with private and public transport in an intermodal interplay. The transportation system design should guarantee a high degree of accessibility to any kind of central places within the city while preserving the cities' cultural heritage and identity. Special consideration has to be paid to differences between cities in the newly associated EU member states and other EU members. Having a cross-sectoral and cross-cultural view, the EU plays a central role in bringing up new and innovative urban research topics. For some types of technological research, economies of scale are possible that cannot fully be exploited at the national level. The EU level is often the proper

[10] For instance: car sharing started in Germany, where MOSES put it on the European level.

scale of the research needed for the development of cooperative systems and intelligent mobility management systems.

According to the Lisbon strategy, EU support could additionally help in the development of new markets for innovative technologies, the transfer of products from national level to European level and the improvement of competitiveness.

3.2 Who Are The Main Actors In The Field Of Urban Mobility?

The active participation of stakeholders in the process of discussion, research, policy making, and implementation gives an important input for the evaluation of research on urban mobility. The key stakeholders identified as particularly relevant in the area of urban mobility are:

- Users and user-related organisations:
  - All transport users and citizens, including pedestrians, cyclists, public transport customers, car drivers;
  - Residents (private residents and businesses).
- Administration, political institutions and other not-for-profit organisations:
  - Supra-national political authorities (European Commission, European Parliament, Committee of Regions);
  - Local/regional/national authorities and their services in charge of transport, environment, urban development, industry, etc. and their related administrative and planning authorities;
  - Road and rail authorities;
  - Non Governmental Organisations (NGOs) / Not-for-profit organisations.
- Businesses (in public or private ownership):
  - Operators of public transport (long distance operators by rail, air or waterborne, and suburban and regional rail/metro/tramway/bus/trolleybus/waterborne systems including stations of different kinds);
  - Urban freight distribution companies (including freight infrastructure such as distribution centres);
  - Transport employees and unions;
  - Mobility service providers such as car sharing or car pooling operators;
  - Architects, designers, manufacturers and transport related industry (e.g. vehicles, infrastructure systems, telematics);
  - Land owners and real estate developers;
  - Energy/fuel suppliers.
- Research providers:
  - Academics;
  - Consultants;
  - Research institutes.

Most administrative and financial responsibilities within urban areas belong to the local or regional levels. They vary according to national policy and legal frameworks. However, implementation of

measures and strategies in the field of urban mobility is mostly influenced by the local stakeholders.

As explained in the Green Paper, the EU can play a key role in influencing the development of sustainable urban mobility.

When looking at key stakeholders for research activities in the field of urban mobility, the interest and impact of the European level depends a lot on the particular research topic. Among other issues, topics related to financing and pricing, Intelligent Transport Systems (ITS), climate change, emissions, organisational aspects of public transport and issues of safety and security are of major interest for the EU so far. A comprehensive elaboration of relevant topics can be found in the EURFORUM State of the Art Report.

While many implementation-focused projects target discussion with local user groups, research projects, which are not closely connected to user aspects, lack input from and discussion with user representing organisations. However, to successfully implement application-oriented research and successfully support (not force) more sustainable mobility behaviour in cities, the users have to be put at the heart of research and development. The best research results will not be helpful if the concept fails in everyday life application and when user needs or preferences are not adequately addressed within these concepts. In this context, special consideration will have to be paid to the acceptance of road pricing or other (earmarked) taxation or traffic/parking restraint regulatory measures, to special user groups gaining weight in the future (like mobility impaired or elderly people) and to groups being of essential importance for the future of Europe (like children and families).

Therefore, EURFORUM has proposed a permanent advisory structure at the European level which can effectively represent stakeholders of European research on urban mobility. This forum could also be helpful to bring up those items that are innovative, maybe unconventional and easily overlooked in the institutional process. The task of the forum will be to provide recommendations for innovative research on urban mobility issues stressing the objective of increased intermodality. The organisation and the composition of such a permanent advisory structure has been the subject of a separate report.

4.Strategic Research Agenda for Urban Mobility

4.1 The Development Process of the Research Agenda

Due to the complexity of the issue and the ambition to frame a Strategic Research Agenda (SRA) on Urban Mobility for Europe the development process has been structured in several steps at two different levels: Level 1 was made up by the EURFORUM consortium, level 2 by stakeholders and experts external to the project.

To develop a common understanding and support for EURFORUM's Strategic Research Agenda, EURFORUM initiated two plenary sessions and an on-line forum for stakeholder consultation. The following steps have been taken (see Fig1).

Fig.1: Development process of EURFORUM's SRA

(1) The EURFORUM consortium composed a State-of-the-Art document[11] (SoA) about urban transport research issues. Additionally a Vision for the Future has been formulated. The SoA and the Vision served as a basic input for the first consultation of and discussion with external experts and stakeholders in the framework of the first plenary session[12] and on-line consultations. This first plenary session gathered 36 stakeholders from 10 different European Countries and representing wide ranging interests.

(2) The outcomes were integrated into the SRA by the EURFORUM consortium and commented on in a second round by additional experts. This SRA is based on the comparison between the SoA (where do we stand with respect to our knowledge) and the Vision (where do we want to be with respect to policy outcomes).

(3) Integrating all comments - also from partners of T-NEG which represented the New Member states - a more elaborated draft of EURFORUM's SRA was presented and discussed at the second plenary session. This second plenary session[13] was attended by 50 stakeholders from 11 countries.

[11] http://www.eurforum.net/html/uploads/media/SoA_FinalDraft_160207_FINAL.PDF

[12] 28th February 2007 in Brussels.

[13] 28th June 2007 in Brussels.

The outcomes of these discussions were integrated into the SRA.

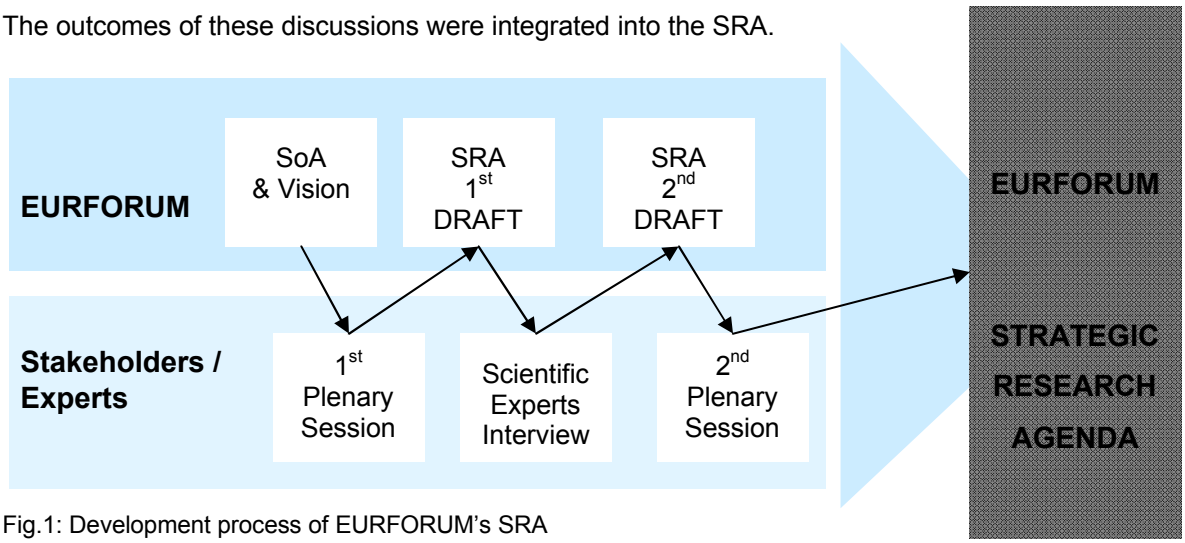

Fig.1: Development process of EURFORUM's SRA

The overall outcome of the development process is the present Strategic Research Agenda which has been broadly discussed with selected stakeholders in the field of urban mobility research thus receiving their validation and creating a broad acceptance not only of priorities in urban mobility research but also of priorities in the coordinated development of urban mobility research. It builds on the identification of research needs and their prioritisation using the perspective of research that is essential at the European level (see chapter 3). This research demand is described in the next chapters.

4.2 Structure of the Strategic Research Agenda: Components of the Urban Mobility System

The Strategic Research Agenda for Urban Mobility is primarily structured along the dimension of the four main components of the urban mobility system.

First, the two components of transport *demand*:

- The users' needs and behaviour: the starting point of both passenger and freight transport;
- The urban structure: land use, urban sprawl and the relationship with mobility and infrastructure;

Second, the two components of transport *supply*:

- Integrated mobility services: services (often ICT-based, like travel information and payment services) that enable a dynamic interaction between demand and supply;
- Integrated transport systems: the 'hardware' of the urban mobility system: road and rail infrastructure, and the operation of public and private road and rail vehicles.

Each of those four system components is assigned to a separate section in this chapter (4.3 to 4.6). Additionally, there is a fifth section: as "data and models" are not easy to assign to a specific component of the mobility system, a separate section is dedicated to this subject (4.7).

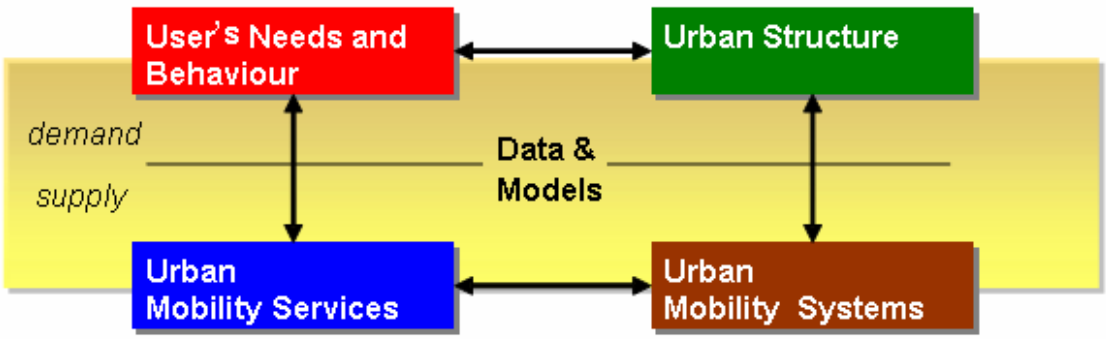

Fig. 2: Components of the Urban Mobility System

Types of research

As pointed out in chapter 3.1, several types of research can be distinguished, such as:

- performing basic research in order to gain better understanding and deeper knowledge;
- research and development: developing new solutions (technology, policy and organisation) based on applied research;
- impact analyses: to determine the impact of solutions on different policy aims;
- research to mitigate implementation and dissemination deficits;

- gathering data and building models.

The latter is an integral part of the section “Urban Transport Demand Analysis And Modelling For Policy Support”. The other types of research are integrated in all sections of chapter 4.

Policy Aims that have to be addressed

According to the EURFORUM vision, the following policy aims can apply to future urban mobility:

- support the prosperity of urban areas;
- support cultural and social interaction;
- support social and economic inclusion;
- ensure accessibility regardless of age, physical ability and social condition;
- ensure safety and security;
- reduce negative impacts on the environment.

All contribute to the objectives presented in the Green Paper ”Towards a new culture for urban mobility”[14].

Although not specified for each section, the policy aims build the framework for research suggested in EURFORUM’s Strategic Research Agenda. Generally, research can focus on how to achieve these policy aims, through an assessment (ex-ante, in itinere or ex-post) of the impact of both changes in the components of the mobility system, and of changes to the system itself.

Structure of the following chapters

Each of the chapters (4.3 to 4.8) starts with a description of the specific topic followed by the main research problems in this field. The core part of the chapters is the description of future topics for urban mobility research. The identified research needs are the outcome of the development process that was characterised by an intense involvement of stakeholders (see chapter 3.2).

[14] COM(2007)551.

4.3 User Needs And Behaviour

Description of the topic

Urban mobility policies can only be successful if the users' needs and expectations are the starting point of the policy making process. A policy option that is not based on a realistic image of user behaviour is unlikely to be successful. In particular, attempts to influence user behaviour have to be evaluated, keeping in mind that sustainability goals are not necessarily the users' goals. Therefore, questions have to be answered like: What demands does a new flexible transport system have to meet to be accepted and successful without inducing new travel needs? Which activity patterns are underlying human travel behaviour? How can this knowledge be used to create more sustainable mobility offers? How can psychological research help to improve traffic safety and prevent hazardous behaviour? Answers to these questions can only be given based on more inter-disciplinary research. They will contribute to a more human-centred and sustainable transport system which focuses on providing accessibility to activities rather than on ensuring transport. Nevertheless, it should not be forgotten that society's ability to change individual behaviours is limited. Studies on the acceptance of measures by users are of great importance for that reason.

The importance of a focus on user needs and behaviour is strongly supported in the Green Paper on Urban Mobility: "Citizens and decision makers have to think in terms of behavioural change. [...] Development of new knowledge, collection of data and monitoring of trends have an important role to play."

Main urban problems

Urban transport systems need to be planned long ahead and have to be adjusted to the needs of future generations as well as to today's users and urban citizens. The most difficult task in this framework is the estimation of future developments in human behaviour, which are not known now but need to be predicted as accurately as possible. Modelling of the complex behaviour and behavioural changes (i.e. in response to soft measures like the introduction of travel information in a city) is not yet satisfactory.

Despite many proceedings in the past, gaps remain in knowledge concerning the driving forces for human decisions on mobility choices. In addition, local policies and measures often lack orientation towards the recipients of their solutions regarding both private users and businesses. The implementation of new mobility concepts failed in the past partially because of a lack of acceptance. The lack of public acceptance of demand management instruments remains a major

obstacle to the implementation of reforms that could help solve problems such as widespread excessive congestion, pollution (air polluters, noise, greenhouse gas emissions), and infrastructure wear and tear.

Also, successful and durable implementation of new concepts depends largely on the actors' involvement, their willingness to cooperate and their support. Active and positive stakeholder involvement can contribute considerably to this.

Main research topics

Better understanding of the mobility behaviour of individuals and firms

Without doubt, much knowledge has already been gathered with respect to the understanding of mobility and transport. System coherences are better understood, but still uncertainties exist concerning the factors that determine individual mobility behaviour. Such factors are: earlier personal experiences with transport options, available transport options and preferences, activity needs, financial ability, etc. Knowledge of these factors determines the success or failure of transport offers, urban structures or transport modes. Since mobility behaviour has to be considered as a complex variable, mobility research has to be performed in an interdisciplinary way to be able to influence it more systematically. The division of mobility research into separate fields like descriptive research, social research, psychological aspects of motivation and market research needs to be overcome.

Specific research items are:

- Better understanding of social determinants of mobility behaviour: Socio-psychological aspects like life-styles, norms, social perception, emotions, status-thinking, personal security, comfort, and so on need to be more strongly considered.
- Mobility behaviour is not only based on rational choices, but also on the image the user has of the components of the mobility system. It is necessary to know better which factors determine the image building of mobility options, and on which conditions an image can be changed. This requires socio-psychological research.
- Better understanding of temporal and spatial planning processes of humans: There is a demand for more comprehensive knowledge on how humans plan their daily activities regarding time and trip planning ("activity-based modelling" of passenger transport).
- Better understanding of the behaviour of shippers and freight transport service providers in the context of their business activities.
- Better understanding of freight transport in its operating human dimension (including how the behaviour of personnel like truck drivers influences delivery routing and schedules).

- The user's willingness to pay for urban freight and passenger transport services has to be further investigated.

Improving the accessibility and sustainability of our cities

It is obvious that transport is an instrument which allows the needs to be met, and not an objective in itself. Thus, the possibility of meeting these needs is usually called accessibility, which may be defined as the realistic option of reaching a doctor, a shop, a restaurant, a workplace, a cinema etc. The realised meeting of these needs is defined as access to services and facilities for whatever purpose users have in mind. It should be noted, however, that at this time no generally accepted method exists as to how realised access can be determined and how this framework could lead to fairer and more sustainable transport planning. Therefore, specific research items at this point in time are:

- Development of an accepted method and identification of standard indicators to determine realised access (e.g. access to fulfil basic needs like shopping for food, working etc.) as the benefit of travel in urban areas;
- Based on this method, thorough observation and evaluation of realised levels of access (meeting needs) and associated costs for this access (internal and external costs like fuel costs, time costs, pollution, noise, accidents, infrastructure costs, etc.). This could help in evaluating urban structures with respect to their accessibility and efficiency and as such allow benchmarking of cities.

Knowing the user: market research

In order to better tailor new transport options to users' needs, more extensive market research is required. Specific research needs are:

- Better knowledge of the Public Transport user: A general concern is that Public Transport does not know neither its existing nor its potential customers well enough. This research should not be limited to the actual user: also (or especially) the non-user can provide very useful information on the choice whether or not to use public transport. The challenge is to establish the link between technical and behavioural disciplines. In this regard, the role of information and communication technologies (ICT) in knowing the customer (personalised info, electronic payment) should be further investigated.
- Perception of safety and security: Safety and security, especially for the vulnerable users, are essential requirements for sustainable mobility. This aspect has to be congruent with the perception of safety and security, taking into account the special needs of customers e.g. women and elderly. Research could provide information on how safety and security corresponds with the users´ feeling of being safe and secure. See also sections 4.3 and 4.6.

- More participatory approach to the user demands: Users and their needs should not only be investigated in an analytical way. Participatory research and action is required additionally to meet users' needs. This type of research will be relevant – above all – during the implementation process of new mobility options.

Impact of policy measures and system innovations on mobility behaviour

In general, policy measures and system innovations are meant to change mobility behaviour of consumers and producers in order to achieve some pre-defined objectives. It is essential to evaluate (ex-ante, in itinere and ex-post) the impacts on urban mobility behaviour, in order to improve effectiveness of mobility policies and system innovations. Also, evaluating the impact of policies on the external effects of transport (like environmental impacts, safety and congestion) has to start with an assessment of changes in mobility behaviour. The following research needs are specified:

- Impact of new information and payment services and media on mobility behaviour: see chapter 4.5.
- Obtaining estimates of adjustment costs related to behavioural changes: People can react to the introduction of policy measures by adapting their behaviour: moving from private car use to public transport, car sharing or car renting, buying a new house etc. All these changes impose one-off costs: time costs linked to the search for a new house, contracting costs (including wages of brokers, notary costs, and registration taxes), and psychological costs.
- The improvement of demand management firstly requires a better assessment of current hard and soft measures. Research on evaluation methods is required for this. Similarly, research is required to better evaluate the consequences of innovative demand management strategies and new mobility management policies (including road pricing) on air pollution, noise and congestion. There is a need to make the social and environmental benefits of mobility policies visible (see chapter 4.7).

Impact of societal changes on mobility behaviour

Apart from policy measures and system innovations, societal changes are also expected to have important impacts on urban mobility behaviour and transport demand. Research is useful on the following items:

- The impacts of future societal changes in cities, for instance the impact of immigration, the increasing pluralism of lifestyles, changing consumer habits, more experiences with new

technologies, changing structures and sizes of households on the demand for passenger transport;

- The same goes for the influence of population and behavioural changes on goods consumption and freight transport demand e.g. delivery services, home-shopping.
- Research could provide information on the linkage between the growing public awareness of security issues and mobility behaviour. In this respect, research should investigate the gap between the security issue as seen by the institutional actors and the security issue as perceived by the public.
- Research in the field of behaviour and travel patterns according to age (children, adults, older people) and to activity (students, working activity, retirement) and bearing in mind the shift in demographics with a growing number of seniors in relation to younger and more mobile people in the future.
- Safety: Research on links between (perceived) safety of the mobility system and mobility choices is required. When trips are avoided as they are perceived as unsafe, this can lead to social exclusion.

How to actively influence user behaviour

With regard to influencing individual user behaviour, the following research demands are determined:

- Research on the relationship between the exact presentation of information on and the promotion of transport and mobility options, and the behaviour of users and non-users. This relates to how this information is understood, how it is used best, how it can be presented considering the recipients' expectations, abilities and needs.
- Special attention has to be given to the differences in behavioural impacts between on the one hand "pulling" factors (e.g. incentives, promotion) and the other hand "pushing" factors (restrictions, legal requirements, road-charging etc.).
- Similar factors occur when implementing new city logistics concepts: How can the concept best be presented in order that individual carriers cooperate?

User acceptance analyses

Measures to influence the mobility behaviour or to steer processes in urban areas more effectively need to be accepted by users. Despite ongoing research there are still questions on how to deal with the lack of acceptance of these measures by the users and how to raise a broad acceptance:

- Road pricing [and regulatory measures in general] can be an effective demand management tool to support sustainable transport modes and relieve congestion in urban areas. Optimal combination of road pricing with other measures (parking policies, changes in infrastructure, stimulating flexible working hours, pricing of public transport, reserved

lanes and prioritisation measures for PT, rewarding of “low emission behaviour”) requires further research. Parking-related congestion is an important research topic, particularly the trade-off between reducing congestion due to cars cruising for parking and the capacity reduction due to on-street parking and double parking.

- Research is needed on how to increase acceptance of pricing policies, e.g. by an appropriate mix of discounts and exemptions. Empirical evidence is useful on the impacts of such measures.
- Multimodal passenger transport concepts: Similar questions arise when promoting new, flexible and multi-modal transport concepts. Determinants of multi-modal behaviour and ways to improve the acceptance of these new offers should be analysed in greater depth.
- Technological solutions: Studies examining the acceptance of new technologies in urban transport (like vehicle technology and ICT). The questions to be ascertained include how a situation can be created where private users are open to new eco-friendly technologies (e.g. through lower costs), and how those technologies can be successfully established on the market.
- Speed management: Research should also focus on the issue of the acceptance of speed management measures by society.

4.4 Urban Structure

Description of the topic

Urban structure is the arrangement of land uses in urban areas. Its interactions with the transport system are bi-directional. On the one hand, the functional differences in land use and the spatial separation of functions create the need for travel and freight transport. On the other hand, the transport system determines the accessibility of places and – at the same time – has a significant impact on land use. This research area is concerned with:

- the relationship between land use and transport demand;
- the impact of transport infrastructure on land use and land value;
- the potential of making the development of our cities and transport systems more sustainable by coordinated planning and management of the urban structure based on sustainability objectives and policies.

Main urban problems

Urban land use and mobility constitute a system of complex interactions. On the one hand, a high degree of spatial separation of functions results in unsustainable use of resources to ensure the mobility of people and freight. On the other hand, in very dense urban structures with overlapping uses, many conflicts between different uses occur. They lead to the need for more space and contribute to urban sprawl. Plans and policies concerning this framework have to deal with diverse objectives, actors and decision-making responsibilities. The wide range of options to take and measures to implement represents a challenge for appropriate urban policies balancing all these factors. Besides gaps in the knowledge about the system itself, know-how and experience are missing about the impact of new instruments and complex measures to control the system. This hinders the long-term development to make urban structures more efficient and sustainable with respect to transport and mobility. Complex institutional structures are divided into sectors, which tend to act, decide, finance and operate for each sector individually instead of investing in time-consuming procedures for better communication and cooperation to achieve integrated urban development. In addition, the Decision Maker's Guidebook of the PROSPECTS project lists the following other barriers: legal restrictions on the use of certain measures, financial restrictions, public and political opposition, physical and technological limits and failure to adopt a logical process for the strategy development.

Cities still need further knowledge to implement fully comprehensive integrated approaches to urban planning at the local level allowing for instance to integrate mobility planning with other urban

policies, in particular land-use planning. Hence, strategies remain uncoordinated, based on short-term objectives or without clear targets. As a result, unsustainable urban structures (suburbanisation, spatial fragmentation, low density) emerge. They lead to increased traffic volumes and travel lengths, as well as to limited accessibility by all transport modes or for certain user groups. Congestion, land consumption, pollution, noise, the great need for road and parking space etc. are examples of outcomes of unfavourable developments of urban structures that increase transport costs and risks. The need for better coordination between authorities and the integration of several policy sectors, such as urban planning, transport, economic and social affairs was also pointed out by the Green Paper "Towards a new culture for urban mobility" published by the Commission in September 2007.

Sustainable Urban Transport Planning (SUTP), a planning approach involving citizens and stakeholders in all stages of the process, provides an answer to these challenges. However, the wide deployment of SUTP in cities is still to be improved and the enhancement of approaches to sustainable urban transport planning requires more research efforts. As the Green Paper states, the Commission will take the opportunity to address the question of SUTP and guidance on how to prepare such plans as part of the Action Plan on urban mobility.

Main research topics

Analysis and assessment of interactions between urban land use and transport

Despite a range of excellent studies carried out in the past, there are still several aspects concerning the interaction between urban land uses and transport development that are not fully understood and need further research. Some of these research needs have emerged due to recent technological, economic or societal developments, for instance the massively increased use of information and communication technologies (ICT); others are motivated by the improvement of methodologies to understand and assess the interactions between urban land use and transport.

Main research needs within the next decade will be:

- Better understanding of influences which determine people's and firms' choice of location; this better understanding will allow measures to be developed for making location decisions more consistent with sustainability goals and adequate policies to be formulated (see also research topic "Developing approaches for integrated planning").
- Evaluation of impacts of different travel modes on space consumption.

Making land development more sustainable through more efficient taxation

An important contribution to enabling a more efficient development of land and to containing urban sprawl could be made by changes in taxation. In today's reality, taxes are levied on the property

value. However, taxes levied on the value of land[15] - land value taxation -would lead to an internalisation of external costs imposed by the development of land, and would discourage urban sprawl. Moreover, earmarking the tax receipts for the funding of the transport infrastructure that leads to an increase in the land value in a given area ("land value capture") can contribute to solving the problem of funding infrastructure (addressed in the section "Funding urban transport" in chapter 4.6, page 61). However, empirical European research on this topic is rather scarce and the implementation of land value taxation could meet a lot of political resistance. Therefore, open research questions remain concerning methodological aspects and questions regarding the instrument's implementation:

- Development of methodologies on how to estimate land value (taking into account that today's real world transactions are related to property, not land);
- Quantifying the individual contribution of publicly provided goods, in particular transport infrastructures and services[16], to the value of a property;
- Identification of needed changes in the legal framework to implement land value capture;
- Measures on how to overcome resistance regarding implementation of land value capture.

More efficient use of existing transport infrastructure

In most European cities, space for traffic takes up about 20% of sealed land and at grade parking can increase this figure. Sealed surfaces for transport should be limited in order to preserve natural space[17] and to leave areas for other uses (dwelling, employment, culture and so on), while enabling an efficient transport system. Research topics to be addressed within this area are the discussion and development of solutions on how to make better use of existing transport infrastructure, especially road infrastructure. These attempts could focus on the optimal allocation of road space for each transport mode, dynamic allocation of road space, new space-efficient transport vehicles and fostering of existing more space-efficient modes (walking, cycling, PT). Questions on how to set incentives for a more space-efficient use of transport, how land use planning can contribute best etc. should be also investigated.

[15] Land refers to that part of property which is not affected by actions undertaken by the owners (for instance, decisions on the number of floors, on the quality of the materials used, concerning the maintenance of the building etc).

[16] This is just one contributor of special importance for the field of urban mobility.

[17] E.g. to protect biological diversity and to preserve and improve the urban micro-climate

Developing approaches for integrated planning

Integrated planning is an approach of outstanding importance to foster sustainable development of cities. Basic research is expedient on conceptual and methodological issues. For example, the Green Paper "Towards a new culture for urban mobility" raised the question of what type of organisational structure could be appropriate to facilitate the development and implementation of integrated mobility plans. Particular research areas are:

- Advanced models integrating land-use, transport and environment. The simulation of land use developments, their impact on transport demand and environment, and the potential of measures is an important tool for planners to deal with the complex system of urban land use and transport. These tools should be advanced and refined by widening their scope and improving the reproduction of the real world. Specific research needs concern the benefits and costs of 'agglomeration' as an urban structure, thus going beyond the mere estimation of benefits and costs related to trips on a given transport link.
- Research on the development of easy-to-use decision support tools which can help local authorities to assess the possible impact of broad integrated policy packages within sustainable urban transport planning.
- Development of adequate policies and measures to make locations of new housing and urban activities more consistent with sustainability goals.
- Development of procedures for systematic transport impact assessment of new land uses in order to enable promotion of better integrated locations.
- Systematic analyses of the advantages and disadvantages of different institutional settings and methods of horizontal and vertical co-ordination in land use and transport planning to determine appropriate organisational structures.

Fostering the use of integrated planning approaches

Besides basic and applied research about how to develop integrated planning, systematic exchange of experience will help to overcome institutional and implementation barriers for land use and transport policies. The awareness and knowledge of the local decision makers are eligible to be improved, certainly of people in positions of responsibility, but also people at the operational level in municipalities, cities or regions. The following research and dissemination tasks will help to foster the use of integrated planning approaches:

- Analysis of training needs and development of further training programmes for professionals across Europe for a better understanding of urban planning objectives and processes.
- Further guidance on the integration of land use and transport planning concerning non-institutionalised methods of cooperation, participation and flexible planning processes to

develop strategies for improving consensus building and acceptance of solutions while speeding up planning processes to build on the work already done in the project PILOT.

- Incentives and support for consistent implementation of municipal environmental plans integrated with other plans impacting the urban development, e.g. by disseminating and using results from the project LIVEABLE CITIES.

4.5 Urban Mobility Services

Description of the topic

This subtopic deals with all services that enhance the dynamic interaction between urban transport demand and the physical transport supply (vehicle operation and infrastructure), e.g. by providing traveller information, booking and payment services, urban freight management services, as well as mobility advice for citizens and enterprises. Such services, which are mostly ICT-based, support a more rational and efficient use of different forms of urban transport, both for passengers and for freight. Moreover, those services support the integration of different forms of urban transport and can be operated independently from transport operators or modes. If services are personalised, they enable better tailoring of the supply to specific user groups. Real-time availability of operational management data forms the basis of those services. There is a strong link with demand management and marketing strategies, which is dealt with in the area 'User Needs and Behaviour'.

Main urban problems

Enhancing the dynamic interaction between transport demand and the physical transport supply is necessary both from the demand and the supply point of view:

- Citizens and companies are not sufficiently aware of all the transport options, e.g. content, quality, price. And if so, this does not necessarily influence their behaviour. Therefore they make inefficient use of those transport options.
- It is still difficult for transport operators and infrastructure suppliers to know their customers well enough and for authorities to know about the varied current and future transport needs of the citizens.

These needs occur in particular in urban areas, where problems of congestion, space consumption and pollution are most severe. Integrated and harmonised services can help to achieve a more balanced use of walking, cycling, public transport, taxis and the private car in urban mobility and to optimise urban freight distribution. This is supported in the Green Paper on Urban Mobility, stating that smart charging systems, better traveller information and interoperability of ITS applications all contribute to an efficient management of urban mobility. Besides, the societal trend of individualisation is still insufficiently picked up by the transport sector. This is especially the case in public transport, where these kinds of services can offer customised solutions within the collective (shared) transport supply.

Also, entrepreneurship in new mobility services (in particular in the public sector, like infrastructure and public transport) is sometimes hindered by unclear organisational and financial conditions. Better customised services will put more focus on the end-user and can therefore help clear up market conditions.

Main research topics

Up to now, this field is dominated by the rapid growth of technological opportunities and by the implementation of separate systems (aimed at different transport modes or based on different technologies). Now that technological solutions start to reach maturity, we start to find out that we know too little about how systems are really used and how they influence both user behaviour and organisation of the transport sector. To take full advantage of all these new opportunities, developments that take place separately should be integrated more and more into one field of personalised services comprising travel information, electronic ticketing and marketing, using the same market segmentation, making use of the same basic data and forming one integrated business case.

In order for such a development to take place, there are still some gaps in knowledge and implementation that require additional research at the European level. In order to encourage private or public parties to invest in these services, the business case has to be clear, especially on the benefits-side. Generally, this requires better understanding of:

- how services are really used, what the perceived benefits are and how they influence user behaviour for the different urban transport systems;
- how systems can be tailored to different user groups (like incidental or frequent users of a system, elderly/disabled, or for passenger travel vs. freight transport);
- how those services can help to achieve urban transport policy aims.

The main research topics are described below.

Towards seamless multimodal transport

The development of a seamless (multimodal) system for passengers and freight will enable a more rational modal choice, but will also make them consider intermodal trip-chains, which is a promising option especially for reducing the dependency on private cars and trucks in central urban areas. The necessary integration of systems, information and charging, still needs developments:

- Information and payment services for different modes would benefit from increased interoperability of the systems, both for passengers and for freight transport. For example, navigation systems, that are already common in motorised individual transport,

should also be established for public transport users, in a better integrated system. The information has to be easily accessible and has to offer reliable, real time information.

- Research should develop information services that include walking and cycling. Positioning systems for cyclists and pedestrians (using GPS and Galileo) have to be developed and applied in a multimodal approach.
- EU could undertake also the compilation and dissemination of good practices for demand-responsive transport schemes to supplement transport services either for targeted groups or in non-dense areas.
- New services for freight delivery must be supported by further research to overcome the lack of efficient urban freight delivery schemes. Research for quiet night delivery, IT and communication systems for trip planning and customer information is needed.
- Developing systems that provide real-time information on the location of the vehicles in the freight transport chain can help to optimise the network and routing of a transport company. Tracking and tracing of goods is possible by using RFID technology. This provides a better service for the customer and also can help to increase the level of security of freight.
- Research is needed on potential synergies between services for passenger transport and logistics.

Compatible urban mobility services

Provision of and access to mobility services differ between cities and regions. This is not only a hassle for the traveller, who has to adapt to different systems, but it is also not efficient from the supply point of view. Research at European level is needed for the following issues:

- Developing standards for interregional interoperability of urban mobility services (like road pricing, e-ticketing, public transport information, etc.) and to learn how ‘white spots’ in the service supply can be filled.
- In spite of useful recommendations through the COST actions (specifically COST 335 concerning the accessibility and use of passenger rail systems) progress has still to be made to achieve a clear, concise and readable signage in public transport networks and their surroundings. Considering the needs of specific groups (like people with cognitive impairment or older people) more knowledge is necessary to achieve “design-for-all” signage. Research and guidance for implementation at the European level will be most useful.
- Car and bike sharing is going to grow in the years to come. It could be better integrated into the urban transport system. Research can answer the question of how these schemes can be made more attractive and competitive. Easy access to car and bike sharing could enable vehicle sharing customers to use all European car sharing

networks. It implies a mutual recognition of the customers, car categories and tariffs as well as a technical convergence of the reservation centres and chip-cards. This means that customers would use one single booking system and would receive one single monthly invoice via their local car sharing operator. Research is needed to define the relevant European standards.

Customisation of services

In order to establish a real dynamic interaction between demand and supply, personalisation of services is an important condition. This will not only improve the quality of the services, it will also enhance the understanding of user behaviour and set conditions for better gearing the supply to user expectations. Research is needed in the following fields:

- How to translate the needs of different user groups (like incidental or frequent users of a system, or elderly/disabled) into functional service requirements, so that those services can be tailored to the users' needs;
- How to personalise services in a customer-friendly way, without too much hassle for the user when providing personal data;
- How to integrate location-based services into the service supply;
- How to sufficiently protect the privacy of users of personalised systems.

A focus on E-ticketing and fare management systems is particularly needed. In practice, increasing revenues for public transport companies would mean an increase in fares, and thus a decrease in the usage of public transport. This can conflict with other objectives of the government: promoting a modal shift from private to collective modes (to improve energy efficiency, to decrease congestion, to reduce local pollution), social objectives, and limiting abuse of monopoly pricing power. On the other hand, economic theory shows that it is possible to develop innovative pricing strategies that allow fare revenues to be increased without affecting global patronage levels.

Examples are:

- Charging higher fares in peak periods
- Moving from season tickets with zero price per trip to season tickets that give a rebate per trip
- Moving to fares that depend on actual distance travelled

There is no urgent need for further work on the development of the economic theory in this field – it is already well established. The biggest obstacles for implementation are data availability (for instance, on the determinants of PT demand) and the administrative burdens linked to complex payment systems. Revenue sharing is an important barrier to tariff integration between

independent operators, and this lack of integration is, in turn, an element that reduces the attractiveness of public transport compared to private modes.

As all these problems can be tackled largely through a wide-scale implementation of electronic payment systems, the main topics to be investigated are:

- Interoperable fare management issues;
- The media to be accommodated (multi-service contact-less passes, mobile phones, credit cards);
- The feasibility of automatic fare collection systems without user-required actions (Be-In/Be-Out systems);
- The possible links with traveller information systems.

The impact and possibility of developing further charging schemes (e.g. variable charges or innovative fare policies through e-ticketing) is another important field for future research.

This knowledge has to be translated into the step-by-step development and implementation of service concepts at EU-level:

- Development of interoperable real-time, personalised and multimodal travel information services across Europe: “Interactive Travel Guidance” on PDA or Smartphone;
- How to integrate personalised information and payment systems, both on the user side and on the data management side.

Development of sound business models and organisational frameworks

Realising high-quality and reliable urban mobility services requires further improvement of the organisational environment. This also involves the development of clear market conditions: who pays for what, who gets which revenues. The availability of independent basic data against fair conditions is an important prerequisite for new market initiatives. The following research is needed at EU level:

- Development of organisational schemes that enable entrepreneurship in service provision and encourage intermodal and interregional cooperation.
- More knowledge on existing experiences to set up the conditions of coordination and cooperation of actors, including the travellers, in these matters.
- Research on sustainable business cases both for future mobility services and network management systems. This requires the development of fair and rational criteria for the assignment of benefits and costs of those systems to the different actors, including end-users, transport companies, transport authorities, etc.

- Traditional models of infrastructure pricing typically assume that the monitoring and enforcement of the pricing schemes can take place for free. However, both in London and in Stockholm, the infrastructure and operating costs of pricing systems have turned out to be rather high (even though strong learning effects have been observed). With the introduction of new systems, interoperability will also become a major issue. Understanding the costs of different systems may thus determine the feasibility of future pricing systems.
- As has been pointed out in the IMPRINT NET project, implementing pricing reforms and deciding on the utilisation of possible revenues (as well as on how to cover possible deficits) raises fundamental institutional questions as to whom bears these responsibilities, and how coordination could best be ensured should these responsibilities not reside with the same institutions. The impact on efficiency of decentralising investment decision-making to lower levels of government, agencies and private firms is a key issue.

Technical issues

In order to enable interoperability of data on different forms of public and private transport and from different cities and regions, sound architectures are needed. Research, development and implementation of ITS framework architectures and system architectures at national and EU levels have to be supported. In order to improve the quality of information, real-time data collection and processing has to be enhanced. More specifically:

- Tools have to be developed that use real-time traffic and travel information data for dynamic/intelligent network management.
- The removal of technical barriers requires research on the development of new technical standards for ticketing, information integration, charging systems and satellite positioning applications as well as research on the interoperability of systems and policies.
- Research efforts should focus on improving data collection on congestion and the environmental situation, using and integrating different data sources like satellite positioning, vehicle and freight tracking, on-board guidance systems etc.

4.6 Urban Mobility Systems

Description of the topic

This chapter deals with the operational and infrastructural aspects of urban transport systems. It addresses passenger and freight transport including all modes: rail and road transport, walking and cycling, private and public transport, including new mobility services such as car-sharing and carpooling. All aspects of the physical transport supply are considered: vehicles, infrastructure, planning, operation and management. Special attention is given to intermodality and integration of systems. Some relevant issues have already been extensively developed and addressed by ERRAC and ERTRAC. They are only briefly referred to in this document, when they seem to be particularly relevant in the urban context.

Main urban problems

Lack of safety and security

Road safety is one of the major problems of urban mobility. In most European countries, two out of three traffic accidents and one third of road fatalities occur in urban areas. Lack of road safety results in private tragedies but has also a high cost for the community (major cause of death for 15 to 24 years old and high economic cost of approximately 2% GDP). There is a high level of vulnerable users injured in accidents: the risk of being killed in a road accident is six times higher for cyclists and pedestrians than for car users[18]. The main cause of the number and severity of accidents in an urban context is excessive or inappropriate speed (mix of traffic flows with different speeds), which contributes to about one third of accidents and is an aggravating factor in all accidents.

As for security, the recent terrorist attacks on the rail and urban passenger transport networks in Madrid and London have highlighted the vulnerability of public transport systems due to the high number of passengers and the easily accessible character of the networks.

Increasing environmental impacts

Except in shrinking cities, forecasts tell us that the traffic volume in cities will increase rather than decrease. All other things being equal, this results in an increased environmental impact. To be

[18] Green Paper “Towards a new culture for urban mobility”, page 16.

noted: freight transport is responsible for about 20-30% of all vehicle kilometres within a city and up to 50% of pollutant emissions. The negative impacts of traffic on the urban environment include: greenhouse gas emissions, such as CO_2, air pollution from other emissions like particulate matter and ozone, noise pollution and vibrations from heavy traffic, and space consumption by infrastructure (including parking space).

Poor integration of the different transport systems

Establishing an efficient urban transport system is too often hindered by the lack of integration and interoperability of the different urban transport systems, both at the technical and policy levels. According to the Green Paper, "there is insufficient attention to co-modality and a lack of integrated collective transport solutions, such as suburban railway systems, tram-train systems, and well-located Park&Ride facilities at collective transport terminals in the outskirts of towns and cities. Freight logistics distribution often requires centres or terminals in suburban areas"[19]. Important conditions to be met are standardisation, coordination between transport supply main decision makers, and better intermodal cooperation between local authorities: administrative structure according to modes does often not allow integration. On the research side, there is also a lack of really innovative experiences combining new technologies and new organisational schemes, with a full evaluation process, though the CIVITAS initiative is a good step forward.

Inadequate pricing and funding of transport infrastructure

Because users do not usually have to pay for the costs their use of transport infrastructure imposes on others, all indicators point to widespread excessive congestion, pollution (air polluters, noise, greenhouse gas emissions), and infrastructure wear and tear. The second most important issue, which is directly linked to the problems described above, is the shortage of public funds for transport infrastructure and the lack of alternative sources.

Organisational framework for non private modes

The market for private modes is without any doubt very competitive. Therefore, there is no need for public authorities to intervene in the market structure of private modes. The issue is quite different in the case of non-private modes (public transport taxis, car-pooling and car-sharing). The problem is finding an organisational framework that maximises the incentives for technical efficiency, innovation and entrepreneurship of transport operators, while keeping prices for customers at a competitive level and minimising the need for public expenditures.

[19] Green Paper "Towards a new culture for urban mobility", page 14

Main research topics

Research in this area has to focus on four main fields:

- Reducing negative impacts of urban transport.
- Integration of urban transport networks.
- Implementation of new urban freight concepts.
- Strengthening of the alternatives to the private car.

Reducing negative impacts of urban transport

Urban road safety: taking into account the mix of transport modes

In spite of a lot of research efforts on road safety at the national and European levels, urban road safety still needs to be tackled, especially considering the increase of vulnerable users (i.e. pedestrian, cyclists, bikers), who are the main victims in accidents. Main research topics should be the following:

- Road safety has to be integrated in urban plans (taking into account the economic costs of accidents), on the same level as noise and air pollution. A special point of attention is the safety in suburban areas, where the traffic differs from that in the core of the city. Safety management, already partly treated in the DUMAS program, has to be actualised and linked with other urban transport policies. Systematic assessments of measures are needed (ADONIS). Safety audits have to be carried out for all kinds of transport infrastructure not depending on transport modes.
- The impact of speed moderation concepts on mobility and urban spreading, and then on safety, have to be established. The issue of acceptance of speed management measures by society and how to increase this acceptance should also be addressed.
- The impact of the increase of cycling on road safety has to be researched. Research is also needed on the specific risks of the growing number of motorcyclists in an urban context and preventive solutions. A special point of interest – an issue for ERRAC - is the design of pedestrian crossings on tramway lines. Especially in danger are people visually impaired, because the new trams are very quiet and have often the right of way over other vehicles.
- Technological solutions for the safety of non motorists have to be developed. Vulnerable groups such as mobility-impaired persons and the elderly should be specific targets for the development of ITS solutions for improving road safety.

Improving the security of transport systems

Understanding the security threat and vulnerabilities of the urban transport system and

consequently better protecting passengers and systems requires major efforts including investment and R&D initiatives. Of main concern is the subject of anti-terrorism in public transport which is relatively new in the European Union. The topic has been picked up in research, but initiatives are recent and no significant results are available yet. Finally the following topics need to be addressed:

- Existing security knowledge and strategies need to be reviewed in the light of the new threat as they did not cover the challenge of intended major destruction and mass casualties. Training programmes have to be set up for security and operational staff. Emergency management schemes have to be developed. Attention has also to be paid to economic aspects (cost, identification of the financial contributors, responsibilities) concerning measures aimed at improving security.
- ITS solutions adapted for PT environment: technology solutions that are currently available have either been developed for operational management and do not serve security purposes or have an airport- or container security background and are not suitable for the environment of urban public transport systems.
- Better integration of safety and security concerns into the design of infrastructure. Especially guidelines are needed on risk assessment for PT enterprises (disasters and terrorism) concerning the vulnerability of PT infrastructures. Vandalism-resistant surface materials have to be developed.

Clean and silent vehicles for an environment-friendly urban mobility

Vehicles (and especially cars) have been a main target of European research for a long time. Although the ERTRAC and ERRAC platforms also address this issue, there are some specific research needs concerning urban areas:

- In order to estimate and evaluate noise emissions in urban areas, both integrated and by transport mode, the various existing noise measurement methods and procedures must be harmonised, in line with the recommendations of the noise directive[20]. It must be ensured that noise abatement can be achieved in all European cities in the future. Data on physical and psychological impacts of noise on human beings have to be included.
- Cities and municipalities must find instruments to facilitate implementation of noise and pollution reduction measures and provide control mechanisms to monitor compliance with the implemented measures. This has to consider both passenger transport and freight transport.
- The impact of traffic slowing measures (for instance changes in infrastructure) and speed

[20] Directive 2002/49/EC on noise mapping

limit control on noise and emissions has to be further studied.

- Municipal (local and city wide) environmental plans have to be introduced with a focus on the integration of environmental data in traffic management decision systems. New tools are needed to predict the impact of traffic measures on air quality. Measures to reduce air pollution have to be integrated with other city policies. See INTEGAIRE's recommendations on priorities in urban air quality research.
- Promising methods for the introduction and testing of alternative energies and new technologies in general and especially in public transportation should be used in order to study other possible pilot applications, like in urban delivery traffic.

Towards integrated urban transport networks

Sharing infrastructures

European city roads and streets are shared by users of more and more different modes of transport, from pedestrians and cyclists to car and lorry drivers. This is much more than a road safety problem. It is necessary to rethink functions of infrastructures from a multimodal viewpoint, considering the efficiency of the different modes and the optimisation of public space and infrastructures. More research is needed in these fields:

- Consideration of public transport and freight simultaneously, as parts of a whole network (i.e. share of road infrastructures including tram, light rail and bus lanes, integration of logistics platforms in multimodal interchange poles). Research is needed in order to help conceive and implement an integrated network and to share the good practices.
- Integration of fully automated road vehicles in the urban environment. Certification of automated road vehicles has to be performed. Advanced and intelligent vehicle management and maintenance systems are to be designed. Safety issues need also to be dealt with, through optimised braking and incident management systems.
- Developing dynamic solutions for urban road infrastructure provision and maintenance like the dynamic allocation of lanes, the use of emergency lanes at peak times, using reversible lanes, etc.
- Concepts for interoperability within and across modes, including vehicles that interact seamlessly across modes.

From interchanges to intermodality

Research is still needed for optimisation of the network and especially of the interchanges. One of the main issues is how to optimise the attractiveness, the safety and the security of transfer facilities between public transport and car, as well as across different modes within the urban public transport system.

This requires an effective organisational framework for planning and operating (multimodal) interchanges. Extended research needs to be carried out on the following topics:

- Integrated design of PT infrastructure (especially interchange facilities) with urban design.
- Improved design and optimisation of transfer facilities (pedestrians, logistics), through simulation of passenger and freight flows and multimodal information, also aiming at the improvement of perception of security and safety, including the interface between urban and interurban transport.
- Research on the effectiveness and potential of Park&Ride facilities.
- Developing solutions for the combination of bike and public transport, like “Bike and Ride”, bike transport with PT or easy bicycle rental.

Towards intelligent integrated network management

Since the DRIVE project, a lot of research has been undertaken at the European level in the field of ITS. Still more research on the following topics is necessary in order to achieve intelligent urban mobility:

- Research on how to develop real-time decision support systems for traffic management. Such systems should respond to a set of variables such as pollution, congestion, weather and social events to ensure an optimal choice between safety and economic objectives. Protocols and tools for effective network management are necessary for this purpose. This includes research on a standard approach for accurate and timely positioning, taking into consideration the potential of Galileo.
- Traffic management integration for passenger and freight transport.
- Benchmarking studies on the urban organisation for traffic management and road network management. Divided responsibilities often are the reason for ineffective local governance.
- In order to test and verify cooperative systems (vehicle to vehicle and vehicle to infrastructure) in the urban context with complex scenarios and interactions, field trials and demonstrations are needed in a real urban traffic environment. They should also prove their positive impact on traffic safety, efficiency and provide the basis for cost/benefit assessment.

Implementation of new urban freight concepts

The last decade a lot of research has been done on innovative approaches in city logistics and city freight. Now it is time to introduce the most promising of these (high-tech) pilot projects into the real world. R&D should focus on the following topics:

- Methods for raising problem awareness and influencing the willingness of all actors to support the implementation of new city-logistic concepts. Introduction of (pilot) applications.

- Development of new techniques for the transport on the last kilometres and introduction of more city friendly vehicles such as small electric or hybrid vehicles. Urban distribution centres and in particular consolidation strategies, vehicle dispatch and the conditions for their financial sustainability (including research on incentives and advantages for city logistics).
- The impact of the emerging use of the internet as it leads to new distribution patterns. Suppliers are competing to provide fast just-in-time delivery, leading to longer, more frequent and less coordinated goods transport movements. Research would be helpful on how to guide this ongoing process and on the effects of societal changes in cities on commercial and freight transport.
- Development of intelligent agent-based technologies: real time software systems that interact with their environment and perform tasks in an intelligent way. They can be used to improve coordination in the transport sector supply chain, leading to a reduction in transport movements. In cities they can also be used for allocating slots for inner city entrance of vehicles when possibilities for entrance are scarce.
- Solutions for avoiding congestion created by the (un)loading of goods. One possibility is the new and dynamic allocation of space for an efficient urban logistic system. Research is needed to define an optimum balance between the benefits of certain technical alternatives (like underground delivery) and their costs.
- Environmental aspects (noise, pollution, energy use) related to urban freight transport: The focus of research should be on the different ways to reduce local emissions: technology, regulation, etc. A special topic is the transport of dangerous goods in urban areas (i.e. continuous tracking).
- Harmonisation of legislation on freight delivery in order to reduce inefficiencies due to the fact that different cities have different rules (for example, regarding the weight and length of the truck).

Strengthening of the alternatives to the private car

Pedestrians and cyclists

Pedestrians and cyclists are the most clean and efficient travellers, but also the most vulnerable travellers. Seamless urban mobility should better integrate these soft modes of transport, which very often constitute the best (or unavoidable in case of walking) solution for the first and last mile of any public transport trip (even private car users need to walk to/from the parking space). The following topics should be addressed:

- Better integration of walking and cycling in transport planning and city design, with a focus on pedestrian safety. Linking walking and cycling improvements with new public transport

provision. Application of positioning systems (using GPS and Galileo) for cyclists and pedestrians, in a multimodal approach.

- Systematic approach for addressing the needs of disabled people.
- Improving safety of vulnerable users, including evaluation of the position of vulnerable users on different types of shared and dedicated infrastructures, and in traffic rules and regulations
- Development of new bike concepts, like electric bicycles, public bikes and bike taxis, both 'stand alone' and complementary to public transport. Approaching the design of cycle paths, often conceived as short distance infrastructure, as a whole network would allow for a wider variety of purposes, including longer distance trips. Benchmarking, the development of a corpus of guidance and the exchange of good practices are needed here.
- Development of other, broader solutions to make public space more attractive for pedestrians, like "day and night living streets" or city "green networks" as they are mentioned in the PROMPT Project[21].

Innovations in public transport infrastructure and rolling stock

Innovations are needed to improve public transport infrastructure and rolling stock. Because most of this research is addressed by the ERRAC and ERTRAC platforms, only the topics which appear particularly relevant in an urban context are mentioned:

- Development of infrastructure and rolling stock that takes into account security, by preventing vandalism, terrorist attacks and major incidents, using ITS and ICT.
- Safer accessibility for persons with reduced mobility: a systematic approach for addressing the needs of disabled people.
- Adaptation of heavy rail urban infrastructure to light rail with harmonised urban/regional rail installations.
- Development of pilot sites and associated research for urban bus systems with a high level of service, considering together the vehicles, the infrastructure and the operating system. Guided bus systems also need more investigation and evaluation.

Public transport operation: better data for improved operation

- Public transport operation is a complex subject which cannot be reduced to data and operating systems. Efficiency and interoperability are to be sought in this matter. More specifically research has to be undertaken on following subjects: Innovative use of ITS, in

[21] PROMPT report summary p. 5, 7, 10, 12 (http://virtual.vtt.fi/virtual/prompt/english.pdf)

order to make public transport operating more efficient. Issues to be addressed include the use of positioning systems (like GALILEO), and the development of cost-effective real-time data transmission between vehicles and operating centres.

- Standardisation of data (i.e., common data dictionaries, generic data models, interfaces and exchange protocols) in order to achieve economies of scale. Integration of data of different modes, collective and individual, should also be a goal. Moreover a generic architecture can be sought with well-defined interfaces between Automated Vehicle Management and Passenger Information Services and data exchange formats with other systems. The possibility of a decentralised implementation of AVM, for simple (possibly portable) operator terminals and for enhanced on-line dynamic tools for dispatchers needs to be considered.
- Exchanges of best practices on how to use data for better operation, like shortening the time needed for public transport to respond to an increase of customers, improved route planning and optimised timetables, better planning of traffic signal control, bus priorities, dynamic control of interconnections, integration of demand-responsive transport services, etc.

Taxis and alternative modes: towards less cars, with more occupants

Taxis have played an important role in city travel for a long time. New alternatives to car use such as shared taxis, carpooling and car-sharing address the problem of ever-increasing car ownership and parking space allocation. Research in this area should focus on:

- Systematic evaluation of the contribution of taxis to sustainable urban transport. Different ways of using taxis have to be considered: used by one individual, or used as collective (shared) services, used for the whole trip or only for the first or last part.
- How to achieve appropriate complementarity between various types of shared taxi operation (fixed routes, demand responsive services) and regular bus services (e.g. night periods, low density areas, transport of disabled people).
- Development of new concepts like large-scale dynamic demand-responsive transport, dynamic carpooling and new short-range mobility systems, including the optimisation tools needed (i.e., software, communication).

Organisational and regulatory framework for urban transport

The organisational and regulatory framework, in which urban transport operates, influences both the behaviour of travellers and the cost of operation of the transport system. Research is needed on the following topics:

- The impact of the taxation regime of the different transport modes (including taxis, car-sharing and carpooling) on the use of these modes (e.g., taxation regime for cars used by

individuals and paid by their employers). Also, potential useful changes in the price and taxation system due to developments in the transport demand and supply have to be studied.

Concerning public transport, comparative international research is needed providing more details on how different regulatory regimes affect the relative performance of operators and the transaction costs linked to contracting, in the light of the new PSR regulation, which imposes contracting, but does not impose tendering. Also, the choice between input and output monitoring as well as the precise specification of outputs in contracts between operators and authorities may demand more reflection. Indeed, observable outputs like the patronage of a network do not depend only on the input from the transport operator but also on external factors. Remuneration based upon output thus exposes the operator to risk for which he will ask to be compensated.

- Concerning the regulation and market structure of "other non-private" modes (taxis, car sharing, car pooling), research should investigate whether there are economies of scale in the operation of telephone or internet dispatch centres, and which organisational structure for urban transport would better achieve the appropriate balance between the benefits of competition within the market and improved modal integration. Again, as with respect to the organisation of public transport, comparative international research on these issues could enlighten us on the factors that influence the regulatory structures.

Funding urban transport

With the shortage of funding for urban transport projects and especially public transport generally observed throughout European cities, research of new funding and/or contracting schemes is crucially needed. PPPs, and land value capture (addressed in chapter 4.4) seem promising. The most important need for future research lies in a better understanding and qualification of the benefits and costs of PPP compared to traditional procurement, both ex ante and ex post, including the role of the taxation regime. One specific research need is how to estimate the transaction costs linked to PPPs. Finally, research should be undertaken on how land value capture and PPPs could be optimally combined, as the use of land value capture could significantly decrease the revenue risk in the case of a PPP project.

4.7 Urban Transport Demand Analysis And Modelling For Policy Support

Description of the topic

Transport demand analysis investigates the generation of travel and transport and the satisfaction of the demand for transport. Transport modelling uses the outcome of empirical transport demand analysis to simulate – as realistically as possible – the behaviour of people and firms. In doing so, transport demand models are mathematical reproductions of the 'real world' using algorithms to describe, explain and forecast the action of 'agents'. As a consequence, models can only work if they have enough valid data to be developed from and calibrated with.

Today, most transport demand models are based on either economic or behavioural theory. Models are used to explain the functionality of the transport system (and to further research it), to forecast travel and transport demand or to assess effects of measures and policies. In such a way, future structural changes of, for instance, population distribution, land use or new infrastructures can be examined with regard to their impact on transport operations.

Main urban problems

As also formulated in the Green Paper "Towards a new culture for urban mobility" the main problems in this field are big gaps in urban mobility statistics and data collection. Furthermore, there is a lack of common definitions so even if data exist they suffer from low comparability. As a consequence, an appropriate and quantitatively valid basis for the decisions of politicians and practitioners is often missing. Comparative studies on the European level, also in the context of benchmarking, are lacking a sufficient basis.

Main research topics

Improvement of data collection on the issue of passenger transport

The availability of valid data is essential for understanding and modelling transport demand and forecasting the future development and thus the traffic situation within the urban environment. Good concepts to influence and manage the transport system can only be developed if we know the mechanisms of people's behaviour and their response to [new] mobility options and transport measures.

Generally, in the field of passenger transport, data collection is more advanced than for the field of freight transport. Nevertheless, there is still a lack of appropriate data especially on non-motorised

modes and on factors influencing the mobility behaviour. In the past, the focus was set on collecting data on trips (travel time, used mode, trip purpose etc.). Over the years, more efforts were made to understand the motivation for the reported trips. As a result, the scope of topics has been widened to research attitudes and lifestyle, the choice of residential location and of locations for certain activities and their implications on mobility behaviour. Research should be supported as this knowledge is especially important e.g. for developing target-group based concepts to influence mobility decisions and behaviour. Furthermore, for both social and economic reasons there is a necessity to improve the concept of accessibility and realised access in order to measure and observe time needed to reach different locations depending on used mode, person group and type of urban area (see research need “Improving the accessibility and the sustainability of our cities”, in chapter 4.3).

Improvement of data collection on the issue of urban freight transport through joint efforts

The lack of consistent and reliable data is one of the major problems in the freight sector. Although there are several data sources available for freight transport, these data cannot be brought together, mainly because they are collected without any coordination between different (private) bodies or institutions. This is true for both the national and the EU level, leading to a lack of reliable, standardised and frequently updated data. In addition, urban freight transport demand often does not show a recurring and stable pattern as passenger transport does. This is another barrier for the collection of reliable and stable data.

Data about freight traffic flows, however, are necessary for policy making. This is not only true for trans-European networks, but also for policies aiming at the urban context, as this is the case, for instance, for the reduction of inner urban pollution by the establishment of ‘environmental zones’.

Investigation about freight data needs therefore should ask – amongst other questions – which data have to be collected locally and how new techniques (e.g. GPS tracing) can help to collect them.

Freight data should go beyond the mere collection of transport flows, but include detailed indications about the shipper (e.g. branch, size of firm, location), the sending (e.g. size, type of packaging, weight, value), the mode of transport (e.g. road, rail, ship, air), the type of delivery (e.g. direct, via storage, bundling of sendings) and the receiver (e.g. branch, size of firm, location). In the urban context, particular attention has to be paid to transport that is related to service industries (including delivery service providers) and industrial crafts or maintenance services.

Standardisation of survey design and indicators for urban passenger and freight transport

The improvement of data collection is closely linked to the requirement of standardisation. Standardised definitions, indicators and methods of data collection should build the basis for benchmarking and comparative studies in Europe when targeting sustainable urban transport

planning. Research on a common standard in Europe should include the specification of important indicators, the definition of these indicators (e.g. definition of accidents or accessibility), related definitions for classification (e.g. common definition of “urban area” and its subcategories), and standards on recommended methods for collection and documentation as well as recommended frequencies to carry out updates of data collection. The need for this improvement has been indicated in several policy papers, e.g. in the recommendations of the OECD Working Group on Sustainable Urban Transport.

Improving methods like data fusion and synthetic matching

Single data sets are usually limited to a specific investigation. To widen their utilisation and explanatory power, research into methods of matching existing standardised and/ or non-standardised data sets and enabling data integration is of significant importance. Therefore, methods and possible frameworks like data fusion and synthetic matching have to be further explored and applied to data collection, utilisation and provision in the field of transport and mobility. Suitable research infrastructures should be investigated in more detail and implemented.

Improving complementary data collection and reliability of data

A range of computer-assisted data collection tools (CADAC) could be used for complementary information gathering: e.g. satellite positioning systems (GPS, GALILEO), mobile communication systems (like mobile phones, PDA’s etc.), intelligent payment systems, automatic image processing, floating car data, and facilities for automatic road charging. These technologies offer the possibility of automatically collecting spatial and temporal movement data (without direct involvement of the respondents). With these highly accurate data the chance of error can be decreased, times for sending and processing data can be shortened, and the costs of data collection can be reduced if generally available hardware and software are applied. As these methods are usually not comprehensive[22], they are complementing but not substituting traditional methods. On the basis of these technologies, higher data availability on urban freight transport and logistics, and higher reliability of pre- and on-trip information and therewith dynamic traffic information and forecast can be achieved. The possibilities of using these technologies and their bonus to transport data collection and processing should be further researched. Best practices and guidance are required concerning regulations for safe use of these data.

[22] e.g. the purpose of trips, which is necessary to understand modal choice, cannot be collected

Strengthening our understanding of user aspects by modelling user behaviour

To date, models are mostly used to simulate operational aspects in the field of traffic management, to support planning activities or to forecast the future demand. Besides much progress with respect to the comprehension of these models, sometimes this is still done by quite rough estimates on aggregate levels or by purely 'technical' data such as, for instance, the number of vehicles counted in the street. Models, however, can make a major contribution to better investigating human behaviour if they are 'microscopic'. This means that they take into account individual action or behaviour and – consequently – individual reaction to changing framework conditions, e.g. by the introduction of new mobility options, or to the implementation of political measures, e.g rewarding low emission mobility. Research on micro-simulation or "agent-based"-models should be strengthened. In doing so, the level of support for political decision making could improve considerably.

A special topic in the area of user behaviour is the response to the increased availability of advanced information technology. Both in passenger (public as well as private) and freight transport, the amount of information available to the drivers, pre-trip or en route, is increasing exponentially. New models should be developed that show how drivers deal with multiple and often contradictory sources of information that affect their travel decisions, their driving behaviour and the formation of habits.

Improvement of transport models integrating all fields of urban planning and management

Current transport demand models and transport simulations are restricted to the sector of transport without taking into account effects resulting from land use changes or impacts on land use resulting from transport measures. At the same time, economic models for evaluation mostly focus on the benefits and costs of "trips" on a given transport link, disregarding the benefits and costs of agglomeration. If transport modelling shall support policy making beyond transport planning, it has to find more satisfactory approaches including effects related to land use and agglomeration (see "Improving the estimates of the external costs of transport") .

Another important aspect for modelling is the assessment of possible detrimental transport impacts on our natural environment. The further development of relevant tools should be fostered to support environmental impact assessment and modelling. This should be made up from models on both transport flows – for both passenger and freight transport – and models concerned with the diffusion of emissions (pollutants as well as noise).

Concerning already existing comprehensive models integrating urban planning, transport and the environment there are different aspects hindering their application:

- Models are difficult or of lacking in quality;

- Input data requirements cannot be met;
- The potential users do not have the skills to use such models or are not convinced of the models' benefits.

Therefore, the lack of quality and extent of integrated modelling of land use and transport requires more research as well as research addressing the input data collection.

One way to further improve modelling is to use more complex and simultaneous modelling tools, implementing modelling aspects both at micro- and macro level and integrating more exogenous factors for the simulation. Research on possible transfers of modelling approaches from other industries on urban transport issues could be helpful too.

Thirdly, regional databases should be developed that constitute a fusion of various data sources concerning different problem aspects, in order to allow modelling, missing data estimation and continuous monitoring of policy impacts within one consistent framework.

Reduction of barriers for practical use of up-to-date models

Despite the fact that transport modelling is a well developed discipline, there is still a great distance between research and practice. In order to bridge this gap, existing knowledge needs to be better managed and disseminated. One helpful tool would be an easily accessible database providing information about the applicability of particular model approaches and models while offering further documentation of locally or nationally used models. While the development of urban transport plans and use of models has to be achieved on at the local level, the EU can help to reduce barriers for the implementation of up-to-date research results for example through funding, support for skills training for the local staff (especially improving the assessment of modelling results), dissemination of research results and good practice etc.

At the same time, there is a high need for practical help for local actors to determine:

- which modelling approaches bring best results with the available data sources;
- which data exactly is required for the transport models they want to use for their specific purposes;
- how missing data can be substituted or bypassed.

Recently a number of EU FP projects have developed model directories and practice guides, in order to assist in the transfer of knowledge from the older to the newer EU-member states. These approaches should be improved and renewed continuously, in order to allow policy practitioners to keep track of the latest findings within the research community.

Improvement of urban freight transport models and support of their application

While freight growth overshadows passenger transport growth more and more, better and more reliable forecasts are necessary for the expected changes in traffic volumes and composition. To support political decision-making, there is a high need to develop freight models that allow a forecast of transport demand for all transport modes differentiated by branches and regions. However, freight transport models for planning purposes are still underdeveloped, in particular network-based models that describe and forecast transport on given infrastructures. This is largely due to the complexity of the interrelation between production, commerce and logistics which is very different from passenger transport. Also freight traffic has unique speed and flow characteristics, different from the usual attributes assumed for passenger car traffic. Although theoretically, disaggregated or micro-simulation models are to be preferred, due to important data limitations aggregate modelling is required in certain cases in order to achieve practicable modelling results in the short term. The combination of economic models and network models should be supported to create a strong tool for policy advice. At the same time, new developments in agent-based freight modelling should aid understanding of responses of the freight sector to policy measures supporting the development of co-modality, urban logistics policies and transport pricing schemes.

Improving the estimates of the external costs of transport

Social marginal cost pricing obviously requires good quality estimates of the costs of transport. However, there remain numerous questions on the appropriate methodology for estimating external costs. Moreover, all existing work is plagued by the difficulty of harmonising evaluation criteria and unit costs for detailed indicators, as well as to make available comparable data.

As pointed out recently by the GRACE project[23], complexity and simplicity are important research issues. It is indeed practically infeasible to calculate the external costs of transport on every single link and node in the transport network for every single time of the day. Therefore the results of external costs evaluation at a meso-economic or macro-economic level shall remain estimates and shall always be questionable. The question then arises to what extent these estimations can be regarded as precise enough to justify decision-making, through a combination of general results obtained in different situations and of more specific estimates of external costs in one particular context. This is especially a concern for congestion and local environmental impacts.

The calculation of external costs requires at least two types of input:

- A model of the relation between traffic flows and external effects

[23] GRACE project: http://www.grace-eu.org/

§ An estimation of the monetary equivalent of these external costs and benefits.

In relation to the first point (the relation between traffic flows and external costs), the following important gaps in our knowledge still exist:

§ With respect to the costs of congestion, different models use different speed-flow relationships and therefore yield different results. Specific points that could be introduced in these models are: automobile characteristics such as car length; nodes congestion; pedestrian-car interaction; pedestrian congestion.

§ The availability of information on exposure to accident risk.

§ The availability of data on noise exposure.

§ Infrastructure costs and scarcity costs are still under-researched areas on which research efforts are lately converging.

In addition, since values in the assessment of external environmental costs can vary by as much as a factor 10, mainly owing to different approaches to exposure modelling, for the two types of inputs mentioned above, research could provide a basis for sensitivity analysis in a given situation, either at the level of a project or of a transport plan.

4.8 Key Aspects for Urban Areas in the EU-12[24]

Description of the topic

As stated in articles 158-162 of the treaty establishing the European Community, one important aspect of the EU's policy is the promotion of an overall harmonious development and strengthening of economic and social cohesion by reducing development disparities between the regions of the EU. Therefore the Union is seeking to stimulate the realisation of the full research potential of the enlarged European Union. Furthermore, urban areas in the newer member states of the EU might have other needs for research and implementation because of a different current situation in those countries. For this reason, EURFORUM was specifically seeking inputs from EU-12 states and looking at their needs.

Main urban problems

One can state that despite many positive developments in urban areas within the EU-12 states, there is still a great need to catch up with developments towards sustainable transport in urban areas in other member states. The problems in research and application concerning urban mobility aspects in these cities and towns are comparable to those in other countries, but are of a higher intensity due to a faster development. The main urban problems characterising some special aspects of these cities' situations are the following[25]:

- Very rapid increase in car ownership (motorisation) led to quickly increasing problems of congestion, traffic safety and car parking in city centres as well as to increasing pollution and traffic noise. Cities were not able to react to such rapid changes by developing long-term-objectives and integrated land-use/transport plans. Instead, the urgency of traffic problems often resulted in a high pressure for quick solutions. The focus for planning and development in many cities was mainly on satisfying the transport demand with road network extensions and renewals without much attention on alternatives. While the pressure has been decreasing lately, local authorities are orientating more and more towards developing long-term, integrated and sustainable planning strategies. The awareness of the necessity of sustainable urban transport plans is rising, not least because

[24]This term is used for the EU-member countries that joined the EU with the enlargements in 2004/2007: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

[25] More detailed information can be found in the State of the Art report of EURFORUM. (www.eurforum.net)

of the EU's incentives. But as in other countries a number of barriers remain, hindering the implementation of sustainable transport planning strategies.

- One apparent barrier is the lack of participation of the public in the planning and development of cities and transport, e.g. because of lack of involvement of local stakeholders by administrations and decision-makers. While this aspect has been improving in the most recent years in some countries, there is still need for enhancements. Another reason can be found in the lack of awareness of those stakeholders concerning their possible contribution and influence and lack of interest in actively participating in planning processes. Both aspects result most likely from the past dictatorial legal structures and overcoming them is a learning process for all actors.
- The lower quality of life in cities with growing traffic as well as the increasing wealth of the population leads to migration towards the outskirts of cities, to rising suburbanisation and urban sprawl. Good practice in the EU-12 shows that some cities have reacted on this development by cooperating with neighbouring communities in order to set up joint land use plans and to better control urban growth. However, the problem is a persisting one. Missing legislation as well as competition between communities for investments and residents are often weakening the planners' attempts to curb suburban sprawl.
- Spatial structures in cities of many former socialist countries are often severely functionally set-up with separated uses of neighbourhoods. The resulting limited mixture of functions leads to a greater need for transport because the inhabitants' needs cannot easily be met within their neighbourhood[26]. In addition the past decay of historical inner cities and mass-produced, pre-fabricated housing in all former socialist states imposes a high burden with great challenges for the renewing of housing and infrastructure.
- The share of public transport in Central and Eastern European States has dramatically decreased - on average, but not in all cases - in recent years. This is for several different reasons, such as the wish of many inhabitants of these countries to finally enjoy the freedom of being mobile with their own car and the decreasing attractiveness of the public transport system[27]. The coordination of public transport services and ticketing among whole regions and urban areas is still lacking and forms another barrier to the use of public transport. Despite this, the share of urban public transport is still relatively high in cities of the Central and Eastern European countries.
- Alternative transport modes like cycling for example are only now developing a better image and receiving more attention through increased infrastructure building, promotion

[26] European Academy of the Urban Environment (2003)

[27] E.g. because of less routes served and reduced operational frequencies

programmes and safety measures. A high potential for improvement remains and in particular a lack of cycling infrastructure feeds into low shares of cycling in most of the EU-12 countries.

- Traffic and mobility management can be considered less developed in many countries of the EU-12.
- There are essential differences between individual EU-12 countries and between cities within one country.

Concerning the removal of these problems, different actions of research, dissemination and implementation have to be taken. But further barriers could hinder this process:

- The exchange of good practice from urban areas in EU-12 between each other and between research and practitioners, which deal specifically with problems in those areas, is not yet as developed as might be helpful. Especially the exchange of these, sometimes unconventional, solutions between urban areas of the new member states is extremely important and should be fostered.
- There are language and mentality barriers which need to be overcome in order to enable effective cooperation and dissemination. The younger generation of researchers and practitioners is highly qualified in the necessary foreign languages. By contrast, the older generation in many Central and Eastern European States did not receive relevant training in English in the past, which is today the major language of research and dissemination throughout the world. Also, the mentalities of working and cooperating differ between Eastern and Western Europe and actors need to be aware of such specific requirements to develop and maintain a well-working research relationship.

Main research topics

As a result, EURFORUM states the following key aspects for further research and development in the field of urban mobility with respect to the EU-12 (in addition to all other research needs within this SRA):

- There were no indicators of research needs in the EU-12 differing significantly from those of importance for other urban areas in the EU. It seems rather important to ensure practical and feasible easy access to research results from other research projects and to improve the transfer of experiences and good practice between urban areas. For more efficient dissemination, research conferences and final project presentations should be held more frequently in EU-12 countries using the local language and simultaneous translations.
- FP7 is already another step towards a stronger consideration of the special needs of cities and towns in the new member states in European research projects. FP7's incentives and

momentum are also fostering and enabling a closer exchange between researchers from all member states. This process should be encouraged and maintained.

- To complement research exchange, much attention should be paid to the exchange of good practices between urban areas within the EU-12, e.g. the extension of the exchange platform ELTIS with a greater focus on also exchanging unconventional solutions for specific problems in these areas.
- In addition, it might also be helpful to provide evaluations of bad experiences and failures made in the past by urban areas in all member states as learning tools.
- The exchange of experiences and city partnerships should focus specifically on the implementation of Sustainable Urban Transport Plans (SUTP) and integrated land-use planning strategies. It should explicitly include cities and urban areas with less developed planning approaches and experiences. It should provide a practice-oriented framework as an orientation for local and national initiatives with clear links to local implementation. There seems to be a high need for unambiguous procedures to evaluate transport policies of municipalities concerning their ability to achieve a more sustainable transport system.
- The development of new ways to apply modelling instruments for the definition and assessment of public and private urban transport demand was identified as one key research field for urban areas in EU-12 as well as the application of progressive modelling instruments (simulation, visualisation). Special attention should be given to a stronger support of the exchange of experiences in transport modelling between older and newer EU member states by the EU, as well as the support of a standardisation of transport modelling approaches throughout all EU members.

§ There is also a huge need for innovative ways to deal with rising transport flows especially in the frontier regions and urban areas, and in respect to freight transport.

§ Another research need worthwhile and important for the newer member states is the improvement of intelligent transport systems with respect to reliability and affordability.

5. Conclusion

When the EURFORUM research consortium prepared this project, it set itself a very ambitious goal: to provide for the first time at the European level a Strategic Research Agenda dedicated specifically to urban transport, from an intermodal, user-oriented, holistic and interdisciplinary perspective.

This report is the result of one and a half years of intensive research and consultation during 2006 and 2007.

Whether or not the goal of the project has been achieved is of course up to the reader to decide.

However, the feedback and the inputs we have received during the stakeholder consultations have convinced the authors of this report that EURFORUM has already moved the debate on the research needs for urban mobility from the backstage to the very centre. We think this is no minor achievement.

However, there is no room for complacency.

The momentum gained through EURFORUM could easily get lost again if there is no adequate follow up.

Therefore, the EURFORUM consortium has also drafted a proposal for the organisation and the composition of a possible permanent EU advisory structure on urban mobility. This structure should lead to a forum of integration, promoting synergetic effects and avoiding isolated sector solutions with high risks of counterproductive negative side effects.

The EURFORUM consortium has advised the Commission that the permanent structure cannot and should not be industry *driven*[28]. On the contrary, it is important that a central role should be played by representatives of local decision makers. Thus, the membership of the permanent advisory structure should be set up in such a way as to create a good balance between

[28] "Industry" in the case of urban mobility refers both to the suppliers of hardware and to the operators.

stakeholders only *performing* research (academic bodies) or only *benefiting from the outcomes* of research (citizens, users) and stakeholders who *finance* the research actions and are *responsible for carrying out research projects results* (European Commission various DGs, Member States, local authorities, operators, suppliers).

The EURFORUM consortium has recommended that the permanent structure should deal with the following topics:

- periodic update of the EURFORUM SRA;
- prepare a roadmap for the implementation for the SRA;
- coordination with technology platforms and ERA-NET;
- provide a structured input for the preparation of the EC FP7 updated work programmes and recommendations towards thematic priority topics for FP calls;
- define and implement the communication and dissemination strategy;
- recommendations targeting public authorities for coordinated R&D and demonstration actions;
- dissemination and communication of standards, theories and good practices of integrated urban transport planning and managing;
- consensus building around strategic actions, including e.g.:
    - the preparation of a charter on R&D targeting “European urban mobility” for more sustainable cities and for the benefit of all European citizens to be signed by public authorities[29];
    - recommendations for pre-commercial procurement targeting intermodal equipment.

****

The finalisation of this report has more or less coincided with the publication of the long-awaited Green Paper on Urban Transport “Towards a new culture for urban mobility”. It is widely hoped that this Green Paper can lead to a structural break in urban mobility policy throughout the

[29] Including endorsement of principles for action in order to facilitate a common understanding of problems, to ease benchmarking on common bases, and to achieve common European specifications on some urban-mobility related technical issues benefiting European cities’ competitiveness and European travellers’ mobility.

European Union. If this report can contribute, albeit modestly, to a similar result in the field of mobility research, the efforts undertaken by the research consortium will not have been in vain.

6. References

ADONIS - Analysis and Development of New Insight into Substitution of Short Car Trips by Cycling and Walking (1999): http://cordis.europa.eu/transport/src/adonisrep.html

CIVITAS - Better and Cleaner Transport in Cities (2006): http://www.civitas-initiative.org/download_center.phtml

CIVITAS – MIRACLES: Multi Initiatives for Rationalised Accessibility and Clean Liveable Environments (2005): CIVITAS – MIRACLES: Multi Initiatives for Rationalised Accessibility and Clean Liveable Environments (17B)

CIVITAS – TELLUS – Transport and Environment Alliance for Urban Sustainability (2006): Demonstrator Fact Sheets of Berlin, Rotterdam, Gothenburg, Bucharest, Gdynia, www.tellus-cities.net (17C)

CIVITAS - TRENDSETTER – Setting Trends for Sustainable Urban Mobility (2006): Sustainable Urban Transport. Final Report from the European Project Trendsetter (17D)

CIVITAS – VIVALDI - Visionary and Vibrant Actions through Local transport Demonstration (2005): Policy Recommendations Report (17A)

Commission of the European Communities (2001): White Paper - European Transport Policy for 2010: Time to Decide, COM (2001) 370 final, Brussels

Commission of the European Communities (2003): Communication from the Commission - Developing the trans-European transport network: innovative funding solutions - interoperability of electronic toll collection systems, COM (2003) 132, Brussels

Commission of the European Communities (2004): Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - Towards a Thematic Strategy on the Urban Environment, COM(2004) 60 final, Brussels

Commission of the European Communities (2005), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Public-Private Partnerships and Community Law on Public Procurement and Concessions, COM(2005) 569 final, Brussels

Commission of the European Communities (2006): Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on Thematic Strategy on the Urban Environment, COM(2005) 718 final, Brussels

Commission of the European Communities (2006): Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee

and the Committee of the Regions Commission, Legislative and Work Programme 2007, COM(2006) 629 final, Brussels

COUNTERACT Cluster of User Networks in Transport and Energy Relating to Anti-Terrorist Activities: Annex 1 to the Proposal No. 022669

Directive 2002/49/EC (2002): Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise, Brussels

DUMAS - Developing Urban Management and Safety, http://www.minvenw.nl/cend/dco/voorlichting/rsst/RSSZ000002.aspx

ECTRI – Urban Mobility Initiative (URBAMOVE); http://www.ectri.org/Documents/Activities/WG/URBAMOVE%20-%20May%202005.pdf

ERRAC - European Rail Research Advisory Council: www.errac.org/ (1, 3)

ERTRAC - European Road Transport Research Advisory Council (2004): Vision 2020 and Challenges, www.ertrac.org

ERTRAC - European Road Transport Research Advisory Council: www.ertrac.org/ (4, 5, 6)

Eurforum Part B (2006): EURFORUM, Contract for co-ordination action, Annex I – "Description of Work", 7th April 2006, Brussels

European Academy of the Urban Environment (2003): Twelve Candidate Countries Overview Report on Sustainable Urban Management, Sustainable Urban Transport, Sustainable Urban Design, and Sustainable Urban Construction, Berlin

European Commission (2006): Communication from the Commission to the Council and the European Parliament - Keep Europe Moving - Sustainable Mobility for Our Continent, Mid-term Review of the European Commission's 2001 Transport White Paper, COM(2006) 314 final, Brussels

European Commission (2007) Green Paper on Urban Transport: citizens and stakeholders have high expectations for European urban transport policy, Brussels http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/756&format=HTML&aged=0&language=EN&guiLanguage=en

European Commission (2007) Green Paper "Towards a new culture for urban mobility" COM(2007)551

European Commission (DG TREN) (2005): European Energy and Transport: Trends to 2030 – update 2005. Luxembourg, http://ec.europa.eu/dgs/energy_transport/figures/trends_2030_update_2005/energy_transport_trends_2030_update_2005_en.pdf

European Environment Agency (1998): Die Umwelt in Europa, Der zweite Lagebericht, Städtische Umwelt (Kapitel 12), Kopenhagen, http://reports.de.eea.europa.eu/92-828-3351-8/de/ (visit 26. March 2007) *// Engl.: State of Environment report No 1/1998*

European Environment Agency (2002): Environmental signals 2002 - Benchmarking the millennium, Environmental Assessment Report No 9, http://reports.eea.europa.eu/environmental_assessment_report_2002_9/en

European Environment Agency (2006): Urban sprawl in Europe - The ignored challenge, EEA Report No 10/2006, http://reports.eea.europa.eu/eea_report_2006_10/en

European Environment Agency (2007): Press release, Transport – bottom of the Kyoto class again, http://www.eea.europa.eu/ *(visit 26 March 2007)*

EXTR@Web (2005): Deliverable D2.A, Thematic Structure and Definitions – all Themes

GRACE (2003): Generalisation of Research on Accounts and Cost Estimation,6th FRAMEWORK PROGRAMME PRIORITY. Call identified FP6-20003-TREN-2

IMPRINT-NET (2006): Implementing pricing reforms in Transport – Networking, Coordination Action of the 6th Framework Programme, Deliverable 1, Pricing for (sustainable) transport policies – A state of the art, March 2006, http://www.imprint-net.org/

INTEGAIRE - Integrated Urban Governance and Air Quality Management in Europe - http://www.integaire.org

ISIS (2007): Civitas in Europe: 'a proven framework for progress in urban mobility'. Rome, Italy

LIBERTIN – Light Rail Thematic Network: http://www.libertin.info/

LIVEABLE CITIES – http://www.liveablecities.org

MODUrban - Modular Urban Guided Transport Systems (2005/2006): Several Project Documents, www.modurban.org

MOSES - Mobility Services for Urban Sustainability (2001): State of the Art Report

OECD/ECMT Joint Transport Research Centre (2006): Speed Management, Paris

PAOLO DELLE SITE (2006): Paolo Delle Site, 2006a, Urban Pricing – From Theory to Reality, Transport Research Knowledge Centre of the European Commission

PILOT – Promoting Integrated Local Transport: http://www.pilot-transport.org

PRISCILLA Bus Priority Strategies and Impact Scenarios Developed on a Large Urban Area: http://www.trg.soton.ac.uk/priscilla/

PROMPT - New Means to Promote Pedestrian Traffic in Cities (2006): http://prompt.vtt.fi/

PROSPECTS (2005) - Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems: http://www.ivv.tuwien.ac.at/fileadmin/mediapool-verkehrsplanung/Diverse/Forschung/International/PROSPECTS/pr_del15dmgen.pdf

UITP – International Association of Public Transport (2005): Strategic Research Agenda for Urban, Suburban and Regional Public Transport and Urban Mobility in the European Union

United Nations General Assembly, Document A/60/121 dated 1 August 2005

UrBike - Maximising the Use of the Bicycle as an Alternative and More Flexible Means of Transport within Cities, www.urbike.net

WALCYNG (1998): How to encourage walking and cycling as alternatives to short car trips and improve traffic safety at the same time; a project in the Programme Package Urban transport, DG VII Transport RTD Programme in the EU's Fourth Framework Programme, Lund

Working Group on Sustainable Urban Transport (2004): Final Report

World Health Organisation (2004): World report on road traffic injury prevention, www.who.int/world-health-day/2004/infomaterials/world_report/en/